

31 DECEMBER 1987



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# ***JPRS Report***

## **Science & Technology**

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***China***

# Science & Technology

## China

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## Activities, Personnel of Xichang Launch Complex Reviewed

### Tour of Xichang Satellite Launch Center 40080003a Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 17 Sep 87 p 4

[Article by Yang Lianghua [2799 5328 0553]: "A Bow Stretched to the Full to Fire At Sirius—A Tour of China's Xichang Satellite Launch Center"]

[Text] Satellite after satellite of various kinds from China traverse the boundless vault of heaven. China's ability to launch satellites into space during the past several years has made a profound impression on the world. People gaze in astonishment, searching for news from the east, watching attentively China's rapidly burgeoning space industry.

It was with the same feeling of fascination which readers experience that the correspondent recently made a special visit to our country's space launch base, the Xichang satellite launch center.

#### China's "Exceedingly High Tower"

More than 300 kilometers southwest of Chengdu, the provincial capital of Sichuan near Xichang City, the capital of the Liangshan Yi Autonomous Prefecture, a winding highway led me to the launch center tucked away in a cluster of mountains.

This is a very long valley in the Maoniu Range, a branch of the Daliang Shan. The verdant mountains, the flocks of sheep like white clouds, the dark green paddyfields, and the men and women of the Yi nationality working beside the streams make up a beautiful picture that is like a pastoral poem. In the midst of this picture, milky white and reddish brown buildings dot the landscape like the stars in the heavens, and various kinds of spherical and parabolic antennas point toward the blue sky. Deep within the valley, a colossus of steel, chin up and chest out, rises from the ground and towers to the skies. This is the satellite launching ground.

Personnel working at the base told me that the entire launch center is made up of six large systems, namely command and control, testing and firing, tracking, communications, meteorology and technical logistics. Several thousand scientific and technical personnel belonging to the National Defense Scientific and Technological Commission toil in this valley deep in the mountains of the motherland's great southwest, working hard to develop China's space industry.

Upon entering the launch area, among several football field-size reinforced concrete launch sites stand gigantic launch towers between 20 and 30 stories high, and beneath the huge launcher at the base of the launch tower is a huge inverted parabolic well that leads downward into the ground and winds its way to reappear at the

surface to the side. The flame emitted when the rocket ignites and lifts off goes through this conducting well and is shot to a slope 100 meters away. Half way up the launch tower, 22 steel arms capable of swiveling 180 degrees horizontally are in the process of lugging an 11 story movable platform. When the rocket lifts off, the arms on both side open wide to send it on its way. At the tip of the launch tower is a large erector beam used to hoist the rocket. Before the satellite is launched, a more than 40 meters long three stage rocket is lifted stage by stage by this beam and pointed directly toward the blue sky.

The correspondent rode an elevator to the tip of the launch tower where engineers were working feverishly. Standing at the very top of the launch tower and looking down at the earth below or up at the vault of heaven, one cannot help but feel exhilarated, and thoughts throng the mind. Doesn't this soaring "exceedingly high tower" symbolize China's rise?

#### Exceptionally Advantageous Launch Conditions

In the command hall at the command and control center located several kilometers away from the launch site, I was given a demonstration of what happens during a satellite launch. A huge television screen resembling a wide movie screen located at the front of the hall showed clearly events at the rocket launch site transmitted by ultra long wave optical fiber cables. Fueling, opening of the launch arms, ignition, lift off, and then a huge burst of flame from the rocket shakes the firmament. The rocket's orbit matches the designed trajectory. On both sides of the television screen, about 100 indicator lights of various colors blink off and on, reporting statistical data transmitted from the launch site, from all monitoring stations and from an instrumentation ship far out in the Pacific Ocean. Here, everything is controlled by large electronic computers, and timing accuracy is one thousand billionth of a second.

At the control center, which concentrates all kinds of sophisticated scientific and technical achievements in a single place, one can experience heartfelt pride at the country's surpassing achievements in modernization.

At the mention of the base's achievements, people told me proudly that the two communications satellites 36,000 kilometers above the equator at 125 degrees longitude and 103 degrees longitude were put up from this site.

The Xichang base was built during the 1980's specifically for the purpose of serving as a center for launching geosynchronous satellites. This base has both the most modern facilities and exceptionally advantageous conditions for launches.

In ancient times, Xichang was called Yuecheng or Moon City. Located at a high elevation above sea level, its air is clear and it has bright azure skies year round. It has as

many as 320 days of sunshine each year, making it a fine "window" for launching satellites. Since it is at a relatively low latitude, it can make full use of the centrifugal force resulting from the earth's rotation. This means a saving in rocket thrust as compared with the satellite launch center[s] in the northern part of the country. It is a fine place for launching earth synchronous satellites.

Some people recall that the location of this launch center had been personally selected by the late Premier Zhou Enlai. In the early 1970's, survey teams made up of experts conducted aerial and ground surveys of 81 counties in nine provinces and regions, coming up with 16 possible sites. Zhou Enlai canvassed experts' views, and repeatedly weighed advantages and disadvantages, finally deciding to build China's communications satellite launch center in this valley at Xichang.

Today, this formerly desolate valley is not only connected with a railroad and a highway, but a large airport has been built not far away. Modern communications lines connect this place with the satellite monitoring unit centered in Xian, and with the highest command organizations in Beijing.

#### A Mysterious Valley Has Opened Wide Its Main Gate

As part of the policy of opening to the outside world, the Xichang Satellite Launch Center has also opened wide its main gate. Since May 1986, it has begun to welcome college, middle school and primary school students, people from all walks of life, and overseas Chinese from abroad, organizing them to develop scientific and technical and tourist activities. At the same time, the base has also welcomed space experts from all countries, and has undertaken the launching of satellites for foreign countries. China's ability to make launches has been favorably reviewed throughout the world.

After passing through one tightly closed door after another, I was ushered into a more than 100 meter long, several tens of meters high test building outside the launch site. In the spacious and spotlessly clean testing room, a large rocket resembling a huge dragon lay silently on a steel rail launcher. This was "Long March Number 3."

Not far from the test building stood an even higher new satellite test building on which work was nearing completion. This test building, which will have maximum cleanliness, and which will have more advanced equipment, was built for the purpose of completing new satellite launch missions.

Following a series of accidents in the United States in 1986, including the destruction of the "Challenger" space shuttle, the explosion of the "Hercules" rocket, and the loss of control and self-destruction of the "Delta" rocket, some countries expressed interest in using

Chinese carrier rockets to launch their satellites. Since it is a launch center, the Xichang Base is consequently engaged in feverish preparation work.

Since 1986, scores of groups from Europe, Asia, the United States, and Oceania have visited the Xichang Center, taking away a profound impression of China's space activities. After visiting Xichang, United States Secretary of Defense Weinberger made the following remark: The launch capabilities here are completely acceptable..."

On the day that the correspondent visited the base, a team of experts from the Arianne rocket launching center in France was looking over the site with an expert eye and asking questions. As to what impressions they took away with them, the correspondent has no way of knowing. Nevertheless, I believe that neither they nor anyone else will be surprised at the steady flow of good news from this place in the future.

#### Launch Center's Director 40080003a Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 17 Sep 87 p 4

[Article by Li Yong [2621 3057] and Yang Lianghua [2799 5328 0553]: "China Sends a Satellite to the Highest Heaven—Interview of Xichang Satellite Launch Center Director Hou Fu [0186 4395]" ]

[Text] He is a man of large stature, with a kindly face, who weighs every word when speaking, is regulated and terse, and who is a first rate educated leader. In the Xichang Satellite Launching Center's command building, we interviewed this highest ranking commander on the base, the witness to the development of China's space endeavors: Xichang Satellite Launch Center director, Comrade Hou Fu. Hou Fu has had a legendary career. In 1945, at the age of 16, he joined the People's Liberation Army in Jilin Province, first as a cavalry soldier and later as an artilleryman. He can measure range by spreading his fingers to estimate distances in laying artillery pieces. During the War to Resist U.S. Aggression and Aid Korea, he served as an artillery battalion commander. Later he was sent for additional study, and in 1958, he became a commander of a test unit for China's first generation of missiles. From that time forward and for the next nearly 30 years, Hou Fu went from northwest China to northeast China, then back to north China, and on to southwest China, in which places he organized the construction of several of the country's sophisticated scientific research test bases, always being in the front line to stimulate each sophisticated scientific research test. During the early 1960's, when he commanded the launching of the country's first short range ballistic missile, he took part in the organization and command of nearly 100 test launches of various types of missiles, rockets and satellites, making an unheralded but major contribution to the country's national defense and to the development of its space endeavors.

When this topic was raised, Hou Fu showed little desire to talk about it. He said casually: "Don't overestimate me. Though I have been to these bases and have taken part in quite a few tests, I am just a common soldier on the sophisticated scientific research front."

"As the highest ranking commander of a rocket launching site, how do you carry out your organization and command role?" we pressed.

Hou Fu thought for a while and replied, "In the completion of a mission as complex as launching a satellite, it is still the master engineers and the technical personnel who do the real work on the front line that play the key role; my job is simply to stimulate their intelligence."

His assistant told us that Hou Fu never places himself in the position of commander-in-chief on technical questions, making off the cuff decisions. Instead, he is always like a common technical person, discussing matters as an equal with everyone, and listening to everybody's views.

"If there is anything special to be said, it is the need to consider matters more fully and make decisions more accurately." Hou Fu told us that in order to insure that launches go off without a hitch, he frequently eats and lives with the technical personnel. For 3 or 4 days before each launch, he sleeps very little, and sometimes he reviews each detail of ground testing all night long, imagining problems that might arise in the course of the launch and formulating ways to deal with them.

People told us that this strict, painstaking, and celebrated commanding officer has yet another facet to his personality. He requires that people be rigorous, be brave in shouldering responsibilities, not be irresolute during times of decisive battles, and be imbued with the determination and boldness of a military man.

On 1 February 1986, after the launch of a broadcast communications satellite was in the final 30 minutes of countdown, something unexpected suddenly happened on the instruments. In the underground command room, the atmosphere was extremely tense for a while. "To launch or not to launch?" Everybody turned their eyes toward the commander. Hou Fu immediately assembled the space scientists and engineers present to conduct an analysis. After hearing their views, Hou Fu said resolutely: "Our product is reliable; it passed ground testing. The Party has put us in this position, and we have to shoulder responsibility!" He picked up the microphone and decisively issued the order to launch. Instantly, there was a tremendous roar, and the three stage rocket belched flame and lifted off to forge through the blue sky. The experts gathered round and clasped Hou Fu's hand tightly saying, "Your are really our good commander."

The resolution that Hou Fu had exhibited during a crucial time resulted not only from his breadth of knowledge and practical experience, but more importantly

from his familiarity with his own preparations, and his understanding of his own workers. He puts his whole body and mind into the endeavor.

During the war years, Hou Fu was wounded. His was a class 3-A disability. A long period in a hardship environment and overly tiring work also resulted in his coming down with many illnesses. But he never paid much heed to such matters. Early in 1987, he was hospitalized for a recurrence of heart trouble. When he heard on a broadcast that China had signed an agreement with a foreign country to launch a communications satellite, Hou Fu could not remain in bed, and asked to leave the hospital several times. He said, "The launching of a foreign satellite is a great honor for the entire nation. As the commander-in-chief, I must be on the spot where preparations are being made!" He hurried back to the base, and then rushed to the launch site, the monitoring station, and to all construction sites....

As the visit was about to end, our conversation turned to the Xichang Launch Center's prospects for development. Hou Fu seemed exceptionally animated, and said to us with a tone of pride: "This center has vitality and stamina. The launching of a satellite for the United States is just the first step in our movement out into the world. Later, there will be more new projects to tackle. In the future, we will not only be able to launch large capacity domestic communications broadcast satellites, multi-purpose global resources satellites, and different types of meteorological satellites, but we will undertake more launchings for foreign countries. When that time comes, China's space endeavors will present a new face to the world.

**Launch Site Support For Civilian Economy**  
*40080003a Beijing REM'IN RIBAO (OVERSEAS EDITION) in Chinese 17 Sep 87 p 4*

[Article by Wei Min [3634 3046]: "Xichang Center Makes Most of Technical Advantages in Active Support to the Building of the Civilian Economy"]

[Text] China's Xichang Satellite Launch Center located in the Daliang Shan in southwestern Sichuan Province has persevered in making the most of advantages to make a greater contribution to the development of the Panxi region. In its role of providing the guiding thought for construction, it has put into effect operational guidance for strategic changes, has devoted attention to making the most of its concentration of human talent and advanced technology, making earnest efforts to use science and technology to help the citizenry. For more than a year, the center has sent out medium and high level technical personnel on more than 250 assignments to replace and improve equipment and to design automatic controls in more than 10 large and medium size enterprises in Sichuan and Guizhou provinces, and to run 12 technical training courses of various kinds that have produced more than 1.4 million yuan in economic benefits.

The freight yard at the east station in Guiyang regularly lost materials being transported as a result of its antiquated management system, and had to indemnify cargo owners every year. After learning of this situation, the launch center's monitoring station in Guiyang dispatched a technical team headed by an assistant engineer to conduct an on-site survey and help design and install a microcomputer automatic control and monitoring system, which greatly improved freight yard management. The satellite launch center also twice sent out a brain-trust and a research unit composed of engineers and technical personnel on assignment to Guanghan County in Sichuan Province, which is the location of one of the pilot projects for reform of the national economic system. There they made a survey of 10 promising projects and signed longterm technical cooperation agreements with the local authorities. Today, the launch center is in process of helping the county's polyester plant with installation and debugging of computers. It is also advising the county on the automation of its office procedures, and setting up requisite conditions for it.

In addition to helping build the civilian economy, the launch center has also made a positive contribution in promoting the building of spiritual civilization. It has already installed four satellite earth receiving stations for the use of 25 entrepreneurial units and educational departments, and it has installed closed circuit television for more than 10,000 viewers. In addition, it has taken the initiative in shouldering teaching and technical training tasks for schools, plants and mines, and it has opened to local institutions of higher learning laboratories that have long been closed to them, thereby providing them with facilities for teaching and field work.

**Launch Center Personnel Training**  
40080003a Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 17 Sep 87 p 4

[Article by Kong Fanlu [1313 4907 4389]: "Launch Center Intensifies Cadre Vocational Training; Scientific and Technical Personnel Constantly Update Knowledge. Busy Studying Deep in Liang Shan Where 'Satellite City' Holds Crack Troops"]

[Text] In order to meet needs in development of the space program, the Xichang Satellite Launch Center has devoted strenuous efforts to updating the knowledge of its scientific and technical cadres. Since 1983, an overwhelming majority of the incumbent more than 1,000 scientific and technical cadres have had opportunity for study and the pursuit of advanced academic work for a steady rise in scientific and technical standards. Today, the launch center has a scientific and technical corps that is not only able to satisfy the needs of existing missions, but that has numerous layers and reserve strength.

Because of the rapid development of modern science and technology in recent years, and the lack of uniformity in the knowledge level of scientific and technical personnel, the launch center has laid down primarily for young

cadres the principle of study based on needs and making up deficiencies in knowledge, carrying out a vigorous program of updating the knowledge of scientific and technical cadres. First, it has forged links with educational institutions to build a foundation for the updating of knowledge. The center has linked itself to Guizhou University, Sichuan University, the Chengdu Academy of Electrical Engineering, and Liang Shan University to build a foundation for the updating of information. More than 400 cadres have studied or taken advanced courses in basic theories, specialized information, and foreign languages. Currently, another 170-odd scientific and technical personnel with a secondary school technical education are taking advanced college courses. In addition, the launch center annually selects a number of outstanding soldiers for training who take examinations to enter college or secondary technical schools for study. As a result, the scientific and technical corps has been steadily replenished. Second, the launch center has sent personnel out and invited teachers in to buttress the updating of specialized knowledge. It has actively organized scientific and technical personnel in set positions to go to industrial plants and research institutes to take part in research and development and the debugging of instruments and equipment, working while they learn to insure that scientific and technical cadres become familiar with the work to which they are assigned within a relatively short time. During 1987, the center sent out more than 300 people to take part in this kind of study. The center has also made sure to leave no stone unturned in inviting experts, scholars, and professors concerned to come to the launch center to lecture and provide guidance, and to advance the study of new knowledge and the mastery of new techniques by scientific and technical personnel. Third is to make the most of the potential that exists within the center, closely linking the updating of knowledge with the campaign for improvement and innovation in the work to which personnel are assigned. Within a period of 3 years, this center has received awards for 188 achievements from the National Defense Scientific and Technological Commission. The new extended parameter testing method for the CA275 rocket carrier responder, which was successfully developed by a young technical worker at the monitoring station, not only enables a testing accuracy far greater than previous requirements reaching plus or minus 1 noy per second. This also results in a saving of money and time, and insures the smooth launching of satellites.

**Launching of Communications Satellites**  
40080003a Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 17 Sep 87 p 4

[Article by Sun Xin'an [1327 2450 1344]: "Communications Satellites and Their Launching"]

[Text] Satellites used for radio communications are called communications satellites. Such satellites are located in space at a distance of approximately 36,000 kilometers above the earth, the time required for each orbit around the earth coinciding exactly with the time

for one complete revolution of the earth on its axis. Thus, when we look at them from the earth, they appear to be stationary. For this reason, communications satellites are also called stationary satellites. Such satellites are "located high and see far." Were one to look at the earth from a stationary satellite, he or she could see more than one-third of the earth's surface area. Were three stationary satellites to be placed in orbit at the proper distance above the equator, it would be possible to communicate all over the globe.

The launching of a communications satellite is an extremely difficult technology that has to be divided into four main steps. The first step is to use a carrier rocket's first and second stage operation and the first ignition of the third stage to put a satellite into a circular orbit (a parking orbit) between 200 and 400 kilometers from the earth. The second step is the second ignition of the third stage rocket to put the satellite into a large elliptical orbit (a variable orbit) 35,786 kilometers above the earth. The third step, which is taken when the satellite has moved to its apogee in this orbit, is to command the on-board distant point engine to ignite in order to change the satellite from its large elliptical orbit to a circular orbit, and to make the plane of this orbit congruent with the plane of the equator. The fourth step is to use ground remote control and small thrusters aboard the satellite to nudge the satellite to the longitudinal position of the synchronous location required so that it becomes a stationary satellite relative to the earth.

Satellite communications have the advantage of long communications distances, a large transmission capacity, high reliability, great flexibility, and contact with numerous locations. They are one of the major ways to develop both domestic and global communications. Thus, communications satellites hold major significance for both military and civilian use.

#### Satellite Launch Drama

40080003a *Beijing RENMIN RIBAO (OVERSEAS EDITION)* in Chinese 17 Sep 87 p 4

[Article by Ma Yinchang [7456 6892 2490]: "Rocket Lifts Off Under His Hands"]

[Text] His are a pair of ordinary hands. He was born into a miner's family, so he lacks no acquaintanceship with coal. First he picked bits of coal from ashes and then he graduated to making briquets by hand, his hands becoming coarse and strong. Three years of life as an "intellectual youth" turned his hands into a mass of callouses.

On 1 February 1986 in the control room underground at the Xichang Satellite Launch Center, these two hands solemnly and unhurriedly pushed a ruby-like electric launch button sending China's first functional communications broadcast satellite into space 36,000 kilometers above the equator.

The owner of these two hands is satellite launch controller, member of the Hui nationality, and assistant engineer Wang Fenglou [3769 7685 2869]. Wang Fenglou, who became 33 years old in 1987, has already worked for 15 years on the front line of space. Deep in the desert, he worked on tasks such as launching carrier rockets toward the Pacific Ocean. At the new space launching site in the Daliang Shan hinterland, he twice took part in China's launching of a synchronous communications satellite, earning a Merit Citation Second Class.

Launching a carrier rocket is not done as offhandedly as setting off a firecracker. In the button size electric launch button is congealed the labor of countless people. One slip of the hand will cause heavy losses for the country. In order to reach this brief moment when he pushes the electric launch button, Wang Fenglou spent heaven knows how many hectic days and nights at the launch site. In the half year preceding the satellite launch, he never saw a movie nor had a day's leave, nor did he go to sleep early. Instead he poured over blueprints tracing circuits and impressed the operating program into his brain point by point. By the time the satellite was launched successfully, he had lost nearly 10 jin!

Perhaps the extraordinarily hectic launch life requires even more greatly varied after hours activities by way of compensation. Fondness for the arts is one aspect of his life. Playing musical instruments and singing is also one of his pleasures; however, he is most adept at reciting Shandong clapper ballads. After getting off work at the launch site, he plays an instrument called the tongbanban, rendering a selection titled, 'Jingyanggang.' He makes himself happy, and everyone becomes happy, ridding themselves of weariness. Possibly it is this special capacity for relaxation that has preserved his psychological balance, enabling him to remain calm and composed in the midst of great turmoil at critical times. Forty-minutes before launch of the communications broadcast satellite, his eyes are riveted on more than 100 switches on the launch control console. A press of a button and instruments as numerous as the stars in the sky will unerringly complete nearly 100 actions in accordance with the commands issued by the launch commander. As his two hands descend, the carrier rocket screams like a huge tamed dragon and flies toward the horizon...

#### Unsung Heroes of Launch Center Praised

40080003a *Beijing RENMIN RIBAO (OVERSEAS EDITION)* in Chinese 17 Sep 87 p 4

[Article by Kong Fanlu [1313 4907 4389]: "Song of Tribute"]

[Text] At the Xichang Satellite Launch Center are numerous scientific and technical cadres who quietly contribute the prime of their life, their intelligence and their wisdom to the country's space endeavors. One of

these is Wang Zhenzhong [3769 2182 1813], the incumbent director of the computer room of the test technology department at the launch center.

In June 1978, Wang Zhenzhong departed resolutely from bustling Xian to enter the ranks of the large pioneering army at the launch center. As the principle permanent cadre for the center's real time computer software, he and his comrades shuttle between Xichang and Luoyang both studying and working. As a result of the hectic nature of the work, this only son was unable to attend his beloved mother's funeral. Overtime work has become his "daily fare," and frequently he is able to sleep only 4 to 5 hours each night for several days on end. For the greater part of 4 years, he and his comrades read several million words of data, took more than 400,000 words of notes, performed more than 300 separate experiments, and finally developed a 60,000 to 70,000 term program in cooperation with a certain research institute. Some one calculated that this was equivalent to the amount of work done on real time software by 100 people working for a year, and nearly one-seventh of it had been completed by Wang Zhenzhong.

During satellite launch preparations, Wang Zhenzhong led the software personnel in strict checking of 18 computer items at the center, promptly eliminating numerous glitches to insure full completion of the launch mission. He participated in research and development of a real time operating program for which he was awarded a Ministry of National Defense Scientific and Technological Commission Merit Citation First Class. He was also awarded a Merit Citation Third Class and a Merit Citation Fourth Class for taking charge of the research and development of an in-house checking and linking program, an external interrupt manager, and a real time data inputting and outputting program.

In order to satisfy the needs of new tasks, Wang Zhenzhong is currently writing a paper titled, "Ideas About Evaluating and Updating the Center's Computer Software." When asked about his future plans he said: "New satellite launch missions are getting closer day by day. As a scientific and technical cadre pressures on me are great! There is no other way except to keep working steadily."

**Stressful Life of Launch Controller**  
40080003a Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 17 Sep 87 p 4

[Article by Li Yong [2621 0516]: "Son Follows Father at the Launch Site"]

[Text] In the underground control room at the launch site, a young man is carefully watching the multicolored cursors on the launch control console. When the "ignition" order comes out of the loudspeaker, he scans the message on the instruments and calmly directs the operator to press the button for rocket flight. His name is Li Lianlin [2621 5114 2651], an engineer in the technical department of the launch center.

Li Lianlin's father is a general who built China's first rocket base during the 1950's. Like his father, he has a special interest in space endeavors.

In 1972, he entered Changsha Engineering Academy. During the years of turmoil, people despised knowledge, but Li Lianlin studied diligently because he realized the correlation between knowledge and rockets. Following graduation, he was even less willing to give up theoretical study and tempering through practice. As a result, he quickly became an outstanding scientific and technical person.

Li Lianlin occupies an extremely important position. During the count down 1 hour before launch, he has to issue almost 100 commands, directing operating personnel to complete nearly 100 actions. If there is the slightest error, the entire launch may be destroyed in an instant. In order to guarantee that nothing will go wrong, he works without regard to whether it is day or night, painstakingly rehearsing day in and day out. His father, mother, wife and children in distant Beijing, who had not received a letter from him for a long time, guessed that he was ill and telephoned several times to inquire. But the letters they received contained nothing but the scrawled words, "I am very well." As a result of excessive fatigue, he passed out at his work table and fell to the floor: his face still carries a brown scar from that. Thanks to his arduous tempering, he fully completed his mission on several satellite launches. The former launch direction and control room that he headed was collectively awarded a Merit Citation First Class, and he was personally awarded a Merit Citation Second Class.

In 1986, a fact-finding group from a certain country visited the launch center where Li Lianlin, in his capacity as the Chinese representative, escorted the honored guests on a tour of some technical facilities. The breadth of his knowledge and his humorous and resourceful gift of gab earned praise from the experts in the fact-finding group. They said, "Mr. Li is not only a first rate commanding officer, he is also an outstanding scientific and technical talent. 9432

### Current Status, Prospects for Software Exports

40080020b Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese 8 Nov 87 p 17

[Article by Cheng Yun [2052 9462] of the Shanghai Municipality Foreign Trade Workers University: "The Current Situation and Prospects for China's Software Exports"]

#### [Excerpts] II. The Current Situation in China's Software Exports

Over the past few years, some of China's engineering colleges and schools, scientific research units, software centers, software companies, and so on have expanded software exports by providing foreign countries with software labor services, data entry, software technology cooperation, contracted software responsibility and other arrangements. Moreover, definite achievements have been made. Qinghua University is an example. It developed software for Japan, the United States, and other countries between 1982 and 1986 for total foreign exchange earnings of \$1,856,700, equal to about 37 percent of China's total foreign exchange earnings from software exports. The university earned more than \$1 million from January through May 1987. Shanghai's software exports for 1987 (including Sino-foreign cooperative development) have surpassed \$1 million.

Software exports come in many forms. They include software personnel labor service exports, contracted responsibility for software with foreign countries, software product exports, software technology exports, and so on. Software product and software technology exports are capable of truly enormous foreign exchange earnings, so software personnel labor service exports often are only the initial stage of software exports. The reason is that through software personnel labor service exports, more advanced software technologies can be imported and all of the expenditures provided by the foreign countries can be utilized. This makes it possible to train a large group of talented people who are familiar with international markets and understand advanced technologies, particularly in the areas of technology export management and administration. This provides an excellent foundation for better foreign exchange earnings from China's software product and software technology exports. During the 6th 5-Year Plan, Shanghai sent more than 100 software personnel to the United States, Japan, and other countries for software technology cooperation and software labor services. It has sent almost 100 personnel to Japan and other countries for software development work during 1987 alone. Tianjin sent nearly 30 software personnel abroad in 1986. China now has about 1,000 personnel in foreign countries involved in software development and software personnel labor services and all are providing rather good foreign exchange earnings.

### III. China's Software Export Prospects

Software development at present mainly depends on human mental labor. It does not require large amounts of capital and is restricted by few conditions. Once software is completed, the marginal costs of reproducing it are approximately zero, so it has extremely high economic returns. Software exports could be rather effective in increasing China's foreign exchange earnings capacity and could provide substantial amounts of foreign exchange. China has abundant intellectual resources and China's S&T personnel are particularly adept in mathematics, logical thinking, software technologies, and other areas. They also are good at difficult mental labor, which suits them to the characteristics of software development and software development work. Their wages are much lower than standards in foreign countries. This gives China's software exports a substantial competitive ability in international markets. Nationally, China has the Chinese Academy of Sciences, the higher education system, industrial departments, science commissions, civilian software companies, and other forces. China has about 210 specialized software development institutes and software applications and development institutes, and it has more than 100 software offices and departments in engineering colleges and schools as well as software centers for each major industry, and so on, with rather solid software development staffs. China now has 33,000 software personnel capable of developing applied software, support software, and systems software for international markets.

China's software personnel staffs are growing continually and emerging forces are appearing. According to statistics from the Chinese Computer Society's Special Commission on Education and Training, the State Science Commission and other systems have the capacity to train 18,000 graduate, undergraduate, and polytechnic students in computer specializations each year. Industrial, educational, and applied departments have the capacity to train 80,000 computer applications personnel each year. Because of existing management systems, enterprise quality and other factors, the results of computer applications in China are rather low and no software market has taken shape in China. Many talented software personnel have been unable to play the role they should. If better organized, their stage would be the international software market with its vast prospects. This would make full use of China's existing personnel resources, expand our software exports, and promote technology exports. This could greatly increase China's foreign exchange earning capacity and provide more foreign exchange, and it could train a large group of export-oriented technical, managerial, and administrative personnel in actual software export work. This would effectively readjust the commodity mix of China's exports and promote the development of foreign trade.

**Electronics Industry Shows Steady Progress**  
40080020a Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese 8 Nov 87 p 1

[Article: "Sustained Stable Growth in China's Electronics Industry—Gross Value of Output From January Through September 1987 Was 30.7 Billion Yuan, Up 54 Percent Over the Same Period in 1986; 47,000 Microcomputers and 119,000 Peripherals Were Produced"]

[Text] Vice Minister Xie Gaojue [6200 7559 6030] of the Ministry of Electronics Industry announced at a news conference on 21 October 1987 that the Ministry of Electronics Industry had achieved sustained and stable production growth in 1987 and that economic results had risen. From January through September 1987, the electronics industry completed 30.7 billion yuan in gross value of industrial output, equal to 95.2 percent of plans for 1987 and up 54.1 percent from the same period in 1986. The predicted gross value of industrial output for all of 1987 may exceed 40 billion yuan, up more than 33.3 percent from 1986. The substantial increase in production has been accompanied by rising economic results. The [electronics industry] system as a whole had 21.7 billion yuan in income from product sales from January through September 1987, up 52 percent over the same period in 1986. Estimated income from product sales for all of 1987 may exceed 30 billion yuan, up 17.6 percent from 1986. Actual profits and taxes were 2.9 billion yuan, up 27.3 percent from the same period in 1986. The total amount of actual profits and taxes for all of 1987 is predicted at 3.68 billion yuan, up 28 percent from 1986. Production of 47,000 microcomputers was completed from January through the end of September 1987, a 2.72-fold increase over the same period in 1986. Computer peripheral production reached 119,000 units, a three-fold increase over the same period in 1986.

Exports of electronic products also have grown substantially. The state has examined and approved 17 export product production base areas and 58 enterprises with expanded foreign trade decisionmaking rights to form an electronics industry export production system on a definite scale. The Changcheng [Great Wall] Microcomputer System will export 2,000 units to the United States and Southeast Asia in 1987.

New advances also have been made in assimilation of imported technologies and work on production within China. Computer projects include construction projects for fourth-generation microcomputers, small computers, software and matching peripherals industries, and

achievements have been made. Chinese-made 16-bit and under microcomputers now account for more than 60 percent of the Chinese market. The Zhonghua [Chinese] learning computer is being produced in large amounts. Production designs have been finalized for the 32 bit Taiji-2220 small computer and 100 units will be placed on the market in 1987.

When discussing readjustments in industrial structures and product mixes in the electronics industry, Vice Minister Xie Gaojue said that the focus during 1988 will be on progress in products that are means of production and on 24 products and eight system projects. The 24 products include small computers, microcomputers, learning computers, software, and information service products.

12539/09599

**Compression Of and Flux Trapped in a Field-Reversed Pinch Plasma Cheng**  
40090017 Beijing WULI XUEBAO [ACTA PHYSICA SINICA] in Chinese Vol 36, No 9, Sep 87 pp 1105-1111

[Abstract of article by Wu Cheng [0702 2052] et al of the Institute of Physics, Chinese Academy of Sciences, manuscript received 20 Dec 85, revised 16 Mar 86]

[Text] A field-reversed pinch plasma discharge device could easily be applied to the construction of a compact toroid in a fusion reactor. The stability of a field-reversed pinch configuration not only is determined by the reversed magnetic flux trapped in the plasma but also is closely related to the compression process and the time evolution of the trapped flux.

Many researchers found that the trapped flux oscillated in their experiments. In the decay process, the number of peaks and the timing were dependent upon the experimental conditions. When two peaks were present, the rising rate and amplitude of the first peak are larger than those of the second peak.

In this work, the compression process is analyzed for a field-reversed pinch plasma on the FRP-1 device. The oscillation and decay of the trapped flux are observed under various discharge conditions. Based on the conservation of the sine of the angular momentum, this phenomenon is quantitatively described. The calculated results are in good agreement with the experimental data.

12553/06662

**Deep Breathing Exercises Affect DNA Structure of Human Body**  
40081022d Beijing GUANGMING RIBAO in Chinese  
4 Sep 87 p 1

[By GUANGMING RIBAO reporter Chen Guangman [7115 0342 2581]: "The Scientific Research Cooperation Team on Deep Breathing Exercises from Qinghua University Discovered that the Secondary Structure of Nucleic Acids Can Be Affected by the External Energy Exerted by Deep Breathing Exercises; They Proved That Human Bodies Can Affect a Material Object Through Alternating Its Molecular Structures and Properties Without Physical Contact"]

[Text] The First Symposium on Deep Breathing Exercises Research, organized by the China Deep Breathing Exercises Research Society, was recently held in Xincheng, Liaoning Province. In this meeting, Lu Zuyin [7120 4809 5593], a research associate from the scientific research cooperation team on deep breathing exercises from Qinghua University and his coworkers reported that, by using modern scientific techniques and advanced research methods, the Qinghua team had made good progress in studying the mechanism of the reaction of matter to the external energy exerted by deep breathing exercises. They approached this study on the basis of modern physics, and observed the changes in nucleic acids—the basic structural material of living organisms—caused by the external energy exerted by a physician named Yan Xin [0917 2450]. They claimed that the external energy exercised by Yan Xin could drive certain chemical reactions, which do not usually proceed under ordinary conditions, forward as well. Authoritative scientists in this field believe that the reported discoveries opened the gate to a bright future for deep breathing exercise research. Their pioneer work proved, with solid evidence, that human bodies can affect matter by alternating its molecular structures without ever touching it. The nucleic acid is a macromolecule. In addition to storing the genetic code that determines heredity, it takes part in synthesizing proteins as well. The Qinghua researchers observed marked changes in UV-absorptions of solutions of a bovine thymus gland DNA and of an enzymic RNA after they had been irradiated for 10-15 minutes in quartz cells by the external energy exerted by Yan Xin. For example, they detected the "hypochromic effect" displayed by the DNA molecule of the bovine thymus gland, which usually takes place when the intramolecular hydrogen bonding that holds the double helix structure together is interrupted. This observation clearly demonstrated that under the effect of the external energy, the molecular structure of DNA had undergone a pronounced transformation.

Because many vital functions of living organisms are performed by biochemical reactions, researchers designed two chemical reaction experiments to study the effect of external energy of deep breathing exercises on the living processes. In the first experiment, they filled a

stainless steel "zero-potential infrared reactor" with "synthetic gas" composed of hydrogen and carbon monoxide, then asked Yan Xin to irradiate the system with deep breathing exercise. A large amount of carbon dioxide was produced in the "reactor" in the absence of heat and catalyst. A second experiment was the bromination of n-hexane. This substitution reaction is usually initiated by irradiation with a light source such as sun light and as the reaction proceeds, the dark reddish-brown solution gradually decolorizes. A test tube was wrapped with 2 layers of kraft paper and filled with a solution of n-hexane and bromine. Yan Xin exerted energy on this test tube on a dark night, and was able to turn the reaction mixture into a colorless solution. These two experiments fully demonstrate that the energy derived from deep breathing exercises can affect certain chemical systems, initiate the reactions and drive them forward. These observations also suggest that healing processes through deep breathing exercise could very well regulate and modify the biological and chemical processes in human bodies to such a degree that they can be practiced to eliminate viruses and bacteria, promote the growth of new systems and help regulate metabolism. Furthermore, many experimental observations in deep breathing exercises can not be fully explained with today's scientific theories and hypotheses. The research progress in this field will bring new challenges to researchers in biology, physics, biochemistry and other basic sciences.

Qinghua University is an established institute with high academic standards in many disciplines and programs. The scientific research cooperation team on deep breathing exercises has made full use of this strength and began their study on the effects of external energy exerted by deep breathing exercises on a molecular level. During the period from December 1986 to March this year, this research team conducted scores of experiments in their spare time to study the effects of external energy exercised by Yan Xin. The results of their study clearly indicate that deep breathing exercise is a science very rich in content, deep and profound. Chinese scientists and researchers should penetrate deep into the realm of this exercise and restore it to its former status as a discipline of human sciences.

12817/12223

**Oral Rabies Vaccine Successfully Produced**  
40081022e Beijing PEOPLE'S DAILY (OVERSEAS EDITION) in Chinese 1 Nov 87 p 4

[By PEOPLE'S DAILY reporter An Yichao [1344 0001 6389]: "Oral Rabies Vaccine Successfully Produced"]

[Text] Changchun, Jilin (New China News Agency)—A new oral rabies vaccine, which can replace the conventional injection-type vaccine, has been successfully developed and produced by researchers and scientists

from the Changchun Biological Products Research Institute and the Pharmaceutical and Biological Appraising Institute of the Ministry of Public Health. This vaccine was approved for use last week.

The new vaccine named "Canine Anti-rabies Vaccine", with a dose of 2-4 mL gives a domestic dog immunity lasting for 15 months.

Professor Chu Juren [5969 5468 0088], the project leader, told us, "This vaccine was field-tested in Guangxi Province and Jilin Province on 20,000 domestic dogs and the results indicated that it is completely safe for dogs as well as other domestic animals in the company of dogs."

He added, "Canine immunization has been the principal means for the prevention and control of rabies, but immunization for dogs by injection is a labor-consuming task; it is difficult and at times even dangerous to carry out. Therefore, the universal administration of canine immunization is restricted. However, this situation should be vastly improved by the introduction of the new canine oral vaccine."

Experts pointed out that dogs are responsible for 98 percent of rabies transmitted to man in China and many other Asian countries. The mass production of this oral vaccine and its wide application will effectively prevent the spread of rabies in developing countries.

12817/12223

**New Rabies Vaccine Developed by PLA**  
40081022b Beijing GUANGMING RIBAO in Chinese  
20 Jul 87 p 2

[Article by Lin Ming [2651 7686]: "New Rabies Vaccine for Spotted Deer Developed by PLA Veterinary College"]

[Text] After 6 years of extensive study of rabies of spotted deer, the PLA Veterinary College has established a unique and fast diagnosis and created an effective vaccine.

A new infectious viral disease among spotted deer—rabies of spotted deer—has been discovered in China. Spotted deer have a 6.3 to 25 percent chance of contracting this disease and once the symptoms of rabies develop, the death rate is 100 percent. This disease presents a great threat to the preserved spotted deer population of 300,000 in China and inflicts an estimated economic loss of no less than 4 million yuan a year, based on the lowest contagion rate. Associate Professor Hu Jingyao [5170 2417 1031] and his coworkers of the PLA veterinary College initiated a systematic and extensive study on this viral disease in 1980 and issued new findings on the virus responsible for this rabies and how it is transmitted. They reached the conclusion that the etiologic agent is a mutated strand of the rabies virus and is transmitted

by exposure to the intact mucous membrane in the digestive tract. This discovery is the first reported in etiologic and epidemiologic research of spotted deer rabies. Since the canine rabies vaccine currently produced domestically is not suitable for spotted deer, Hu and his coworkers developed an anti-rabies vaccine—Weishisuoju erlian [7614 3044 2747 5497 0059 5114]. More than 5,000 spotted deer have been immunized with this vaccine and the preliminary results are satisfactory. The vaccine can usually shorten the course of the disease.

12817/12223

**135th PLA Hospital Succeeds in Treating Hemorrhagic Fever**

40081022c Beijing GUANGMING RIBAO in Chinese  
3 Sep 87 p 2

[Article by Cai Chunguang [5591 2504 0342] and Chen Junhua [7115 6511 5478]: 135th PLA Hospital Achieved a First-Rate Performance in Treating Epidemic Hemorrhagic Fever"]

[Text] Since 1985, the medical staff of the 135th PLA hospital in Jinan Military District, guided by the spirit of total devotion to serving the people, has successfully treated 285 cases of epidemic hemorrhagic fever with moderate medical equipment and under less than satisfactory conditions. more than 30 percent of these cases are either serious or critical and 97.6 percent of the patients recovered. Their achievement in treating this disease should be ranked among the best in the country.

The 135th PLA hospital is located in Jiaozhou City (the old Jiaoxian), Shandong Province. The epidemic hemorrhagic fever has remained endemic here, and is characterized by its severity and viciousness and high death rates; it poses a great threat to the well-being of the local people. In order to remove this health hazard and to alleviate the suffering of the people. In order to remove this health hazard and to alleviate the suffering of the people, the medical staff of the 135th PLA hospital set out to improve the care rate. Since no specific therapy is known, they started with extensive research into the literature, then established a treatment procedure conforming to its symptoms and signs: restore the patient's blood volume immediately upon hospitalization and administer appropriate doses of vasodilators and diuretics at the same time to protect against hypovolemic shock and prevent kidney damage by maintaining normal urinary output. If the patient is already in hypovolemic shock or suffering a serious effusion, definitive treatment is given to bring the blood pressure back up as soon as possible. The third step is to give patients with severe cases added hemorrhage coagulant together with appropriate amounts of whole blood or frozen plasma. Fourth, patients experiencing little or no urinary output are given vasodilators and heavy doses of diuretics and administered with a continuous extradural nerve blocking procedure. This triple-barreled treatment has

achieved most satisfactory results. Last November, Tang Renchu, a local peasant, contracted this disease. When first admitted to the hospital, he was in a coma and suffering from suppressed urine excretion which lasted for 7 days and massive hypodermic bleeding. The medical staff gave him the new treatment and after 18 days the patient recovered and was discharged from the hospital.

12817/12223

**Hepatitis Virus DNA Found Outside Liver Tissue**  
40081022a Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 14 Aug 87 p 1

[Article by Gao Zhu [7559 2691], special correspondent: "Zhou Siliang [6650 1835 0081] and Zhao Liansan [6392 6647 0005] Made an Important Discovery in Hepatitis B Research- Hepatitis B Virus DNA Found Outside Liver Tissue for the First Time"]

[Text] New research findings on hepatitis B, "A Study on the Viral Infection of Hepatitis B", in which Zhou Siliang [6650 1835 0081], a Ph. D student of Sichuan Medical College, and Zhao Liansan [6392 6647 0005], a young school teacher, collaborated, were well received by a review board of experts in this field which was organized by the Higher Education Bureau of Sichuan Province. The subject of this project is one of the "research topics given major emphasis" designated by the National Education Committee. All the panelists agreed that the aforementioned work achieved the advanced international standard and contributed valuable information to the study as well as to the prevention and control of hepatitis B virus.

In order to explore the infection mechanism of hepatitis B, over the past two years, Zhou Siliang and Zhao Liansan, under the supervision of Professor Cao Zhongliang [2580 6988 2733], a renowned expert in epidemiology, used the molecular cross-breeding and other modern research techniques to detect and determine the presence as well as the distribution of hepatitis B virus DNA in the body organs of extreme cases. They disclosed that, in addition to the liver, there is widespread invasion by the polyvalent type of hepatitis B virus into many other organs in various systems in the body. The presence of hepatitis B viral DNA in uterus, testicles, adrenal glands and lymph nodes was detected for the first time. This finding has never before been reported. Furthermore, they observed that pathologically, necrosis of liver cells occurs only in areas of the liver invaded by the hepatitis B virus. Microscopic examinations of specimens from patients did not reveal any irregularities in other organs which had also been infested by the hepatitis B virus. The two young scientists considered this "isolated phenomenon" a most significant discovery in the study of the infection mechanism of hepatitis B. Also, they were able to confirm, for the first time, the instruction of attenuated type hepatitis B virus in the bodies of those with severe cases of hepatitis B.

12817/12223

**Prospects for Plant Hormone Brassica Lactone Reported**

4008123a Beijing RENMIN RIBAO [PEOPLE'S DAILY] in Chinese 23 Jul 87 p 4

[Text] When flowering wheat was treated with one part per 100 million of a certain Brassica lactone, productivity increased by 10 percent. When cucumber seedlings were treated with 1 part per 10 million of the Brassica lactone, productivity increased by 30 percent. This achievement was announced yesterday to the news media by Shen Yungang [3088 0336 6921] and Professor Nobuo Ikegawa, formerly of Tokyo Institute of Technology.

This applied research leads the international community.

At present, five kinds of plant hormones are recognized worldwide—growth hormones, gibberellin, cell division hormones, abscisic, and ethylene. These five kinds of hormones and their derivatives have been used widely in the manufacturing process as agents that control the growth and development of plants to increase productivity, weed out the weak strains, speed up ripening, and maintain freshness. These applications have resulted in great social and economic benefits. Brassica lactone is the only plant hormone that can remain in plants. It has been called "the sixth hormone." Its hormonal activity is higher than the other hormones and its realm of application has expanded from fruit and vegetables to grains.

In the last 2 years, units such as the Shanghai Botanical Institute and the Shanghai Pharmaceutical Institute have used Professor Nobuo Ikegawa's samples, and applied the Brassica lactone to experimental crops in such places as the Shanghai suburban area and Henan, and obtained successful results.

12996/09599

**Third Protein Factor Gene Separated From Yeast**  
40082023c Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 8 Jun 87 p 1

[Text] During his study at the University of California-Irvine, Instructor Qin Shiliang [4440 1102 5328] of the Biology Department of Beijing Normal University isolated the gene of the third extended factor (EF-3), and showed the world for the first time the objective existence of the factor, and its function, in the bio-formation of protein. This research result has received strong reaction and attention from his overseas colleague. Recently, a top international biological journal, the American "Journal of Biochemistry" (JBC), accepted his dissertation for publication.

The formation of protein is one of the very basic activities of life. In general, the extended process of the bio-formation of eucaryotic protein requires two different protein factors, i.e., EF-1 and EF-2.

Ten years ago, American scientist Scrogins found a specific associated factor in yeast, without which the bio-formation of protein would stop immediately. This was called the third extended factor EF-3. However, because the biological function of this factor was not known, and because of its apparent absence in other eucaryotic cells, theorists were doubtful of the objective existence of EF-3. Although many scientists such as Professor Kilpatrick of the Medical School of the University of Wisconsin tried to isolate the gene of EF-3 to further explore the biological function of EF-3, their efforts were not successful. Therefore, this topic remained unresolved.

At the end of 1984, Qin Shiliang went to the United States to further his studies. He studied under Professor McLaughlin, a renowned American expert in yeast genetics and molecular biology. His research topic was EF-3. In more than 1 year's time, Qin Shiliang conducted a large amount of intricate and difficult work. He isolated and purified EF-3 protein, prepared the EF-3 antibody, and used a recently developed method called immunoselection to isolate for the first time the gene of EF-3. Also, he was able to obtain large amounts of genetic expression from yeast cells. He further determined the site and number of couplers on the 5' and 3' ends of the EF-3 gene. He used right-angle alternating electrical field chromatographic electrophoresis to determine the sites of the chromosomes. He used molecular biology techniques and conducted gene fracture experiments and proved that EF-3 is a necessary gene. In June 1986, Qin Shiliang finished the entire verification task. He took this achievement to Canada in September 1986 to attend the 13th International Yeast Genetics and Molecular Biology Conference. Many experts and scholars congratulated him.

This achievement of Qin Shiliang opens a new avenue of research in the study of secrets of the bio-formation of protein. Because of this, his work has repeatedly received recognition by Numorell, Fellow of the U.S. National Academy of Sciences and renowned biologist. Professor McLaughlin also praised Qin Shiliang as the best researcher in his laboratory in the last 20 years. After he finished his studies, he declined the invitation to stay on in the United States, gave up excellent conditions for experimentation, and returned to China according to plan. At the present time, he is applying for national science research funds to continue his in-depth research of the functions of EF-3 and the mechanism of bio-formation of protein.

12996/09599

**Achievements in Plant Cell Engineering Reported 40082023b Beijing RENMIN RIBAO /PEOPLE'S DAILY/ in Chinese 24 Jul 87 p 4**

[Text] During the last decade, the Chinese Academy of Sciences has achieved significant advances in basic research in plant cell engineering. In the past seedlings

only came from seeds. Nowadays, asexual propagation technology has produced more than 90 strains. Strain selection using regular procedures may take many years, but it only takes a few years if pollen haploid technology is used. Furthermore, the research staff used hybridization to produce plants that had never grown on earth before. This shows that China is among the leaders of the world in this field.

Plant cell engineering is an important component of modern biological technology. Generally speaking, it involves "operation" on plant cells according to human design to transplant, combine, induce mutation, even repair cells. The results are new cells, and plants that are more beneficial to the production process.

One of the most important achievements of cell engineering research at the CAS is the establishment of many propagation systems that grow separate from the parent plants, and the ability to regenerate the strains in test tubes. Asexual propagation means the proliferation of the organism without the combination of the male and female cells. Agricultural, horticultural, and medicinal plants can all be propagated rapidly and successfully. For example, orchids flower in 5 to 7 years under normal growth conditions. The research staff was able to induce test tube strains of "white-center orchid," *Cymbidium faberi* and *Cymbidium goeringii* to flower year-round. More than 60,000 seedlings of test tube sugar cane have been planted in Guangxi Province in the last 5 years. Almost 10,000 test tube eucalyptus trees have been planted in southern mountainous areas and have become forests.

In pollen haploid research, the Chinese Academy of Sciences is in a leadership position in the international scene. The staff was the first to successfully culture pollen strains from 4 families, 10 genera, 13 species and varieties. These include wheat, maize, pepper, carrot, and three-leaf rubber. Even more notable is that the staff achieved major advances in elucidating the regularities of pollen culturing, which determined the proper growth periods and conditions for the culturing of pollen. High quality growth cultures were developed and were used widely. According to sources, the staff has used pollen haploid technology to develop new strains of tobacco, wheat, and wet rice. The staff was able to obtain high quality asexual strains of rubber and sugar cane, which is a first in China and abroad.

The CAS has made great strides in research in the regeneration, recombination, and mutation of plant protoplasts. It has developed strains regenerated from protoplasts of more than 30 different kinds of plants. It was also first among all nations to develop protoplast regenerated strains from the following plants: maize, *digitalis*, *celery*, *onion*, and *polypogon monspeliensis*. Following Japan, the staff also developed protoplast regenerated strains of wet rice, and propagated second generation descendants. In the combination and hybridization of protoplasts, the staff established a complete line of cell

hybridization techniques, and successively cultivated many inter-genera and inter-species hybrid strains such as tobacco, short blue-bell, carrot, and celery. The staff also developed 11 hybrid cell systems from the combination of soybean and tobacco protoplasts.

12996/09599

### Milk Powder Used as Medium in Nucleic Acid Hybridization

40081008c Beijing SHENGWUHUAXUE YU  
SHENGWUWULI JINGZHAN [PROGRESS IN  
BIOCHEMISTRY AND BIOPHYSICS] in Chinese  
No 2, Apr 87 pp 70-72, 69

[Article by Guo Xiaojun [6753 2556 6511], Wang Shenwu [3769 3947 0063], Zuo Qin [1563 3866], Han Ricai [7281 2480 2088], Wang Zhaoqi [3076 0340 3823], and Wu Guanyun [0702 0385 5366], Fundamentals Department, Chinese Xiehe Medical College, Beijing: "Use of Milk Powder in Nucleic Acid Molecule Hybridization"]

[Text] Abstract: Nucleic acid spot hybridization was done using lot fat milk powder and SSC to form a simple nucleic acid molecule hybridization system. Comparisons were made with Southern and Northern imprint hybridization as well as Benton bacteria stripe *in situ* hybridization, and with conventional hybridization systems. It was demonstrated that this system is simple, reliable, and inexpensive, suiting it for use in laboratories in general.

In recent years, nucleic acid hybridization techniques have found increasingly widespread use in the screening of recombinant DNA, gene analysis, the locating of genes on chromosomes, and gene diagnosis for various genetic illnesses and infectious diseases.[1] Nucleic acid hybridization is mostly conducted on solid membranes. In order to minimize non-specific absorption by the membrane, and to increase the probability of collision among single stranded molecule nucleic acid, i.e., to increase sensitivity and lower background, large molecule Denhardt reagent, salmon sperm DNA (or its RNA) as well as D-glucoside sulfate are usually added to the hybridizing solution. Though hybridization results have been very satisfactory from the use of these methods; nevertheless, many reagents are needed, and certain difficulties are frequently encountered in the spread of gene diagnosis techniques. For this reason, we have tried to find a simpler yet reliable and inexpensive method.

In 1984, David A. Johnson et al reported use of Bettelo's reaction medium from which very good results had been obtained when combining nucleic acid with large biological molecules such as protein.[2] Bettelo's most important ingredient was non-fat milk powder. Subsequently, some laboratories abroad used non-fat powdered milk in DNA molecule hybridization.[3]

We used a low fat milk powder produced in Beijing to conduct some trials and improvements of nucleic acid hybridization systems and methods, obtaining fairly satisfactory results.

### Materials and Methods

1. Milk Powder and Associated Reagents. Wannianqing Brand low fat milk powder produced by the Beijing Southern Suburbs Dairy Products Plant.

a. Milk powder solution. 5 percent (W/V) of milk powder in aqueous suspension and stored at -20 degrees centigrade.

b. Milk powder hybridizing solution. 0.25 percent milk powder, 6 x SSC (0.15 mol/L NaCl + 0.015 mol/L sodium citrate), prepared fresh for use.

c. Milk powder membrane cleansing solution. 0.25 percent milk powder, 0.1 percent SDS (dodecane basal sodium sulfate), 2 x SSC made up fresh for use.

2. Preparation of Nucleic Acid Hybridization Probe. Use the alkali denaturing method [4] and the carboxyl apatite [5] method to prepare a recombinant plasmid containing specific gene segments. After the recombinant plasmid has been meiqie [5326 0434] with an inhibiting endonuclease, the electrophoresis-DE 81 filter paper method [6] should be used to recover the specific gene segments. The recombinant plasmid or the specific gene segments should be labeled, using either the <sup>32</sup>P or the <sup>35</sup>S notch translation method,[7] and the Sephadex G<sub>50</sub> colonette centrifuging method [8] should be used to recover the probe, its volume being 100 gm l.

3. Cellulose Nitrate Membrane. Products of 0.45 gm porosity from any of the following may be used: the West German S&S Company, the Shanghai Pharmaceutical Institute Research Institute, or the factory affiliated with the Beijing Chemical Industry School. Before use, the membrane should be washed in distilled water twice for 15 minutes and the membrane checked for even absorption of water (the membrane with even water absorption being selected). After immersion in 6 x SSC, spotting with specimen, or transfer of nucleic acid should be done. Please see the notes for Figures 1 - 4 for the spotting and nucleic acid transfer method.

### 4. Hybridization Method

a. To prehybridize, put the cellulose nitrate membrane carrying the DNA or RNA to be checked into a plastic bag. Add between 3 and 10 ml of the prehybridizing solution, and after heat sealing it, place it in a 60 degrees C water bath to prehybridize for 2 hours.

b. Hybridization. Boil 100 ml of the  $^{32}\text{P}$ - or  $^{35}\text{S}$ -labeled DNA probe solution at 100 degrees C for 3 minutes. After quick chilling in an ice bath, add the small amount (between 1 and 5 ml) of the prehybridization liquid remaining in the plastic bag. The radiographic specific activity of the hybridizing solution will be approximately  $2 \times 10^6 \text{ cpm/ml}$ . After sealing, put it in a 68 degree C water bath to hybridize over night (for 16 hours or longer).

3. Washing the membrane. Pour off the hybridizing solution and reserve (at -20 degrees C) for repeated use. Remove the hybridizing membrane from the plastic bag and wash as follows:

a. Wash twice in a 0.25 percent powdered milk membrane washing solution for 15 minutes at room temperature.

b. Wash twice for 30 minutes in a 68 degree C water bath made up of 0.1 percent SDS, and 0.1 x SSC.

4. Autoradiography. After drying the hybridizing membrane with filter paper, put it in a Shanghai membrane freshness preservation bag, and then attach it tightly to an X-ray plate (of Chinese manufacture), and put it in an exposure clip equipped with a sensitizing screen at low temperature ( $^{32}\text{P}$ , -20 degrees C) or ( $^{35}\text{S}$ , -70 degrees C), and develop between 6 and 72 hours exposure.

## Results

### 1. Spot Hybridization

Figure 1 [not reproduced] shows the signal produced following use of an  $^{35}\text{S}$  probe on a known DNA hybridization using a milk powder nucleic acid hybridizing system. There is a marked distinction between specific DNA and non-specific DNA hybridization points; the probing level may reach 10 pg.

Different dilutions of HBV DNA and salmon semen DNA were added to an equal volume of 0.4 M NaOH and mixed for 1 minute at room temperature. Then two times the DNA solution volume of 20 x SSC was added, and an extraction filter specimen spotting device was used to spot a cellulose nitrate membrane. A 3.2 Kb segment of  $^{35}\text{S}$ -marked HBV DNA was used as a probe. After hybridizing in a milk powder hybridizing system and washing the membrane, it was exposed to light at -70 degrees C for 4 days. A is the HBV DNA, and B is the salmon sperm DNA.

Figure 2 [not reproduced] shows the use of a milk powder nucleic acid hybridizing system in which a  $^{32}\text{P}$ -marked specific probe was used to check results of a patient's genome DNA. Homologous plasmid DNA's positive control signals were strongest. For 19 patients, the genome DNA had varying degrees of development signals, showing the system's fairly high specificity.

Genome DNA specimens of 2.5 gm g were spotted using active I<sub>1-8</sub>, II<sub>1-8</sub>, and III<sub>1-3</sub> tissue from a total of 19 cervical cancers. A  $^{32}\text{P}$ -marked PHPV-16 was used as a probe and hybridized in a milk powder system. It was developed after 15 hours exposure at -70 degrees C. III<sub>4-5</sub> is 2.5 gm g of DNA from human cervical cancer cultured cells. III<sub>6</sub> is a salmon sperm DNA negative control of 2.5 gm g. III<sub>7</sub> is a PHPV-16 (containing a nipple shaped tumor virus DNA recombinant plasmid), 1ng, negative control.

### 2. Southern Imprint Hybridization

Figures 3 A, B, and C [not reproduced] show the same cellulose nitrate membrane, providing results from the use of the traditional hybridizing system and the milk powder hybridizing system under different conditions. Inasmuch as washing of the membrane caused a reduction in the amount of DNA on the membrane, the development signals from the three gradually weakened; nevertheless, their images on the plates are entirely identical. When the milk powder hybridizing system is used, results from the addition of 50 percent formamide at 68 and 42 degrees C are the same.

A. Electrophoresis following Hinc II digestion of white cell DNA 10 gm g from a patient having beta Mediterranean anemia; Southern shift using traditional hybridizing methods to hybridize.[11] Probe was a  $^{32}\text{P}$ -marked lower case delta-cytoglobin gene specific 1.3 Kb segment. B. After membrane A was boiled for 3 minutes at 100 degrees C, the same probe was used for hybridizing in the milk powder system. C. After boiling of the membrane in water, the same probe was used, hybridizing being done in a milk powder system containing 50 percent formamide at 42 degrees C.

### 3. Northern Imprint Hybridization[10]

Human red cell total RNA and negative control RNA undergo agarose electrophoresis at the same time. A human eta cyoglobin non-specific  $^{32}\text{P}$  probe was used for hybridizing in the milk powder hybridizing system after the Northern shifted to the cellulose nitrate membrane. Figure 4 [not reproduced] results show specific zone bands clearly.

Total RNA from a mouse plasma cell tumor, and total RNA (B) from a human reticulocyte, using 180 gm grams of each. After the Northern has shifted to the membrane[10], use a milk powder hybridizing system containing 50 percent formamide at 42 degrees C to prehybridize for 2 hours. Then add an alpha  $^{32}\text{P}$  marked human beta pearl protein gene probe (after denaturing at 100 degrees C for 3 minutes), and hybridize at 42 degrees C for 16 hours. Wash the membrane and expose to light at -70 degrees C over night; then develop.

### 4. Benton Bacteriophage *in Situ* Hybridizing[9]

Figure 5 [not reproduced] shows the hybridization images when the powder hybridizing system was used with lambda bacteriophages on hand to form phage spots when specific probes were used for screening. We had already used this method to screen a beta Mediterranean anemia gene clone strain from the DNA in the spleen of a beta Mediterranean anemia patient. This demonstrates fully the practicability of this hybridizing system.

After encapsulating and screening DNA from the spleen of a patient suffering from beta Mediterranean anemia, Hind III 7.5 Kb segments and  $\lambda$  charon 38 DNA recombinant, and propagation of positive bacteriophage spots, a  $^{32}$ P-labeled beta cyoglobin cDNA probe was hybridized in the milk powder hybridizing system and the membrane washed. It was exposed to light at -20 degrees C for 6 hours and then developed.

## Discussion

For convenience in using the milk powder hybridizing system, we used the centrifuging method to prepare a small volume of probe. After prehybridizing, it is not necessary to change the hybridizing fluid. The probe may be directly added to the milk powder hybridizing system. If a fairly large volume of probe fluid is required when another method of preparation is used, additional compounding may be done as the make up of the prehybridizing fluid requires.

Some academicians[3] have added salmon semen DNA to the milk powder hybridizing system in order to lower the background. Our results show that there seems to be no need for such an addition. When the background is too high, it is usually because cellulose nitrate membrane absorption is uneven.

The report of Johnson et al says that the milk powder system may also be used as a medium for determining protein-protein immunity. We have not made any tests in this regard. Baylor Medical College in the United States has used this system in research on protein-nucleic acid probe linking under the name of southwest: "n imprint hybridizing, and obtaining satisfactory results.

The mechanism for using low fat milk powder in nucleic acid hybridization remains unclear. On the basis of the principles involved in conventional hybridization systems, we speculate that it plays two roles as follows: (1) Location effect: During prehybridization, the large biological molecules in the milk powder are absorbed into the blank parts of the cellulose nitrate membrane, thereby reducing the membrane's non-specific absorption of the probe DNA; (2) Volume exclusion effect: When the spaces between the large molecules of the probe are entered by the large molecules of the milk powder in the hybridizing fluid, the relative viscosity of the probe is increased and the renaturation of the probe DNA is reduced, thereby causing a rise in the degree of specific hybridization.

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**Gene Engineering of Lipochromosomes, Eukaryocytes**  
40081008a Beijing SHENGWUHUAXUE YU SHENGWULI JINZHAN [PROGRESS IN BIOCHEMISTRY AND BIOPHYSICS] in Chinese No 2 Apr 87 pp 23-28

[Article by Yi Jianhua [2496 0256 0948], Biology Department, Wuhan University: "Gene Engineering of Lipochromosomes and Eukaryocytes"]

**[Text] Summary.** This article emphasizes the new technique of using lipochromosomes as carriers for transferring a eukaryon gene to another eukaryocyte (chromosome preparation and assaying, and lipochromosome transfer of genes and their assaying). Lipochromosomes not only promote gene transfer and improve gene stability, but they can also increase genome activity. Current techniques for inserting a gene into a eukaryocyte usually require expensive materials and equipment and are limited to special types of cells. By comparison, the lipochromosome gene transfer technique is simple, the various different kinds of cells serving as target cells. Because of this unique characteristic, this technique should become an extremely useful tool for the gene engineering of eukaryocytes.

At present numerous techniques exist for implanting genes into eukaryocytes externally, including the following: 1) the direct microscopic injection method (Capocchi, 1980 and Anderson et al, 1980); 2) the polycation method (Pagan 1969); 3) the calcium phosphate sedimentation method (Graham et al, 1973); 4) the virus carrier transfer method (Hamer et al 1979), and Shimojo et al, 1981); 5) the red cell blood shadow fusion method (Straus et al, 1980); 6) the liposome carrier transfer method; the liposome carrier transfer method; (2-5) 7) the minicell carrier transfer method (Ruddle, 1981); and the 8) chromosome carrier transfer method. [6-8] Inasmuch as there are limitations to the use of the aforementioned methods for transferring eukaryon genes, research based on chromosome carrier transfer methods and liposome carrier transfer methods has been undertaken in recent years to establish a lipochromosome carrier transfer method. By lipochromosome is meant the composite produced by enclosing a chromosome or a segment of it in a liposome. [1] Use of lipochromosomes as carriers not only promotes eukaryon gene transfer and improves gene stability, but can also increase genome activity. Lipochromosomes are new carriers that hold very great hope for the gene engineering of eukaryocytes. This article outlines the complete technique for lipochromosome gene transfer and the application to eukaryocyte gene engineering of lipochromosomes. In addition, it discusses the huge potential for the lipochromosome transfer of eukaryon genes to eukaryocytes.

### 1. Lipochromosome Preparation

Determination of whether there is an advantage to chromosomes serving as carriers for eukaryocytes has to be based primarily on the effectiveness of liposome encapsulation of chromosomes or chromosome segments, and the effectiveness with which lipochromosomes carry genes to receptor cells.

The raw materials used for preparing liposomes and the method by which liposomes are prepared are the key to increasing effectiveness in the above two regards. There are quite a few materials [0] and methods that can be used to prepare liposomes (Table 1, and Table 2), the ones to be selected depending on specific circumstances.

The raw materials used to prepare liposomes influence in many ways the effect on receptor cells of the carrier gene material (chromosome DNA, chromosomes and chromosome segments, virus DNA and virions).

Considerable research has demonstrated that the nature of the electrical charge of phospholipids markedly affects the ability of liposomes and cells to fuse and cell absorption of liposomes. [2,9] Even though the mechanism whereby liposomes carry genetic material to receptor cells is presently not entirely clear, nevertheless, whether by deglutition or fusion, or whether through fat exchange or some other method, [10] a certain affinity between the two is necessary before the contents can be transferred

within the receptor cells. The kind of phospholipid that makes up the liposome, and particularly the nature of the liposome charge correlates directly to this function. Fraley [11] used phosphatidyl choline (PC) to prepare liposomes with a neutral charge, and he used phosphatidyl choline and stearylamine (PC-SA) to prepare positively charged liposomes. He used phosphatidyl serine (PS) or phosphatidyl glycerol (PG) to prepare negatively charged liposomes, which he used to encapsulate SV40 DNA. Then he incubated them with monkey kidney cells, discovering that the amount of PS liposomes and PG liposomes that had united with the monkey kidney cells was between five and nine times again as much as when PC or PC-SA liposomes were added to PS, and these liposomes were incubated with monkey cells, this increased the volume of lipids that united with the monkey kidney cells, and they formed a direct correlation to the amount of lipids and the amount of added PS that united with the monkey kidney cells. This showed that negatively charged liposomes had a higher affinity for monkey kidney cells than did liposomes carrying a neutral charge. Consequently, they interacted readily with monkey kidney cells, and this helped the transfer of their contents to the monkey kidney cells.

In addition, the kind of phospholipids that make up the liposomes, the proportion of various kinds of lipids, the degree of phospholipid saturation, and even the freshness of the phospholipids all affected the stability of the liposomes, and the stability of the liposomes is a prerequisite for insuring that the genetic material will avoid damage before entering the receptor cells. For example, even though PS and PG negatively charged liposomes are equally able to unite with receptor cells; nevertheless, since PG liposomes are not as stable as PS liposomes, their leakage rate is higher. As a result, the amount of the contents of PG liposomes that is carried to receptor cells is correspondingly less, thereby lowering the effectiveness of the carried genetic material. It was additionally discovered that when liposomes prepared from phospholipids alone were incubated with receptor cells, throughout the entire period of incubation there was a leakage from receptor cells of liposome contents that caused a decline in carrier gene material efficiency. [11] When a proper amount of cholesterol was added to these liposomes, stability of the liposomes was increased, and leakage from receptor cells of liposome material was effectively prevented. [11] The experiment showed that liposomes prepared from oxidized phospholipids that were not fresh were of poor stability, and that there was a marked decline in their effectiveness in encapsulating various materials (including genetic material). The oxidized materials contained in liposomes prepared from oxidized phospholipids were toxic to receptor cells. [19]

The liposomes that encapsulate genetic material required a fairly large amount of aqueous phase spaces. Changes in the make up of liposomes can increase the aqueous phase spaces in liposomes. For example, the addition of a certain amount of cholesterol to PG or PS liposomes can achieve this goal.

Overall, current research shows that when  $\Delta$ C, PS and cholesterol raw materials are combined in certain proportions, and the Szoka and Papahadjopoulos (1987) reverse phase evaporation (REV) method is used to prepare negatively charged, large unilamellar vesicles, encapsulation of chromosomes is good. This is because there is a strong affinity between such liposomes and receptor cells (animal cells, that is); thus chromosomes can readily enter receptor cells. Furthermore, their large aqueous phase spaces are able to encapsulate chromosomes effectively.

Table 1. Kinds of Phospholipids Used To Prepare Liposomes, and Their Electrical Charges

English Name	Abbreviation	Electrical Charge
Phosphatidyl choline	PC	0
Dipalmitoyl phosphatidylcholine	DPPC	0
Lysophosphatidyl choline	LPC	0
Phosphatidyl ethanolamine	PE	0
Dimyristoyl phosphatidylethanolamine	DMPE	0
Sphingomyelin	SM	0
Phosphatidyl serine	PS	-1
Phosphatidyl inositol	PI	-1
Phosphatidyl glycerol	PG	-1
Dicetyl phosphate	DCP	-1
Dimyristoyl phosphatidylglycerol	DMPG	-1
Diphosphatidyl glycerol (Cardio lipid)	DPG(CL)	-2
Dimyristoyl phosphatidic acid	DMPA	-2
Phosphatidic acid	PA	-2
Stearylamine*	SA	+1
Cholesterol*	CHO (Cho)	0

\*In preparing liposomes, the addition of a certain amount of cholesterol can increase the stability of the liposomes and prevent leakage. It can also increase aqueous phase spaces in liposomes. In the preparation of positively charged liposomes, stearylamine is usually added. Since the preparation of certain liposomes requires the use of cholesterol and stearylamine, they have been listed along with the phospholipids.

Table 2. Types of Liposomes and Their Method of Preparation

Name in English	Abbreviation	Methods of Preparation
Multilamellar vesicle	MLV	Mechanical shaking method (Hand agitation method)
Small unilamellar vesicle	SUV	Ultrasonic method
Large unilamellar vesicle	LUV	1. Ethyl ether injection method 2. $\text{Ca}^{2+}$ -EDTA chelating method

Table 2. Types of Liposomes and Their Method of Preparation

### 3. Reverse phase evaporation method

#### 2. Chromosome Assay

The following several methods may be used to assay whether chromosomes contain liposomes:

a. Fluorescent Microscope.[1,12] Separate metaphase chromosomes and dye them with fluorescent dye.[13,14] Use reverse phase evaporation to prepare large unilamellar vesicles to encapsulate the fluorescent chromosomes (fluorescent liposomes). Add the fluorescent dyed chromosomes to pre-prepared large unilamellar vesicles to serve as a control. Place the fluorescent dyed chromosomes and the control specimens under a microscope for observation so as to be able to see clearly the luminescent chromosomes inside the lipochromosomes. When HBSS is used to cleanse the lipochromosomes, the fluorescent dyed chromosomes will stick tightly to the liposome membrane without the slightest separation from the liposome membrane, demonstrating that these chromosomes have encapsulated liposomes. No liposome membrane will be visible around the outside of the liposomes that serve as a control, thereby demonstrating that they are just a mixture of chromosomes and liposomes, and that the fluorescent chromosomes have not yet encapsulated the liposomes.

b. Electronic Microscope Assaying.[1] Following fixing and embedding of the lipochromosomes, slice them continuously for examination under an electron microscope. The existence of a lipid lamella around the chromosomes will be visible.

c. Isotope Analysis.[1] After encapsulating the isotope, marked chromosomes in liposomes; the situation as to the encapsulation of liposomes in chromosomes can be determined on the basis of the radioactivity count. (Figure 1).

#### 3. Assaying of Lipochromosome Transfer of Genes

a. Selection of Gene Transfer System. In order to better assay effectiveness of chromosome transfer of genes, a suitable system for chromosome transfer of genes has to be selected. Such a system must include donor chromosomes, receptor cells and a transfectant. Usually, donor chromosomes or chromosome segments are obtained from hybrid cells. Donor chromosomes and chromosome segments must contain marker genes (chromosomes that have been labeled) that are available for selection, and the receptor cells should be without such marked genes that are available for selection. The receptor cells accept the donor chromosomes and their genes to form a transfectant. The marked genes obtained by the transfectant may be assayed at two levels. The first is an

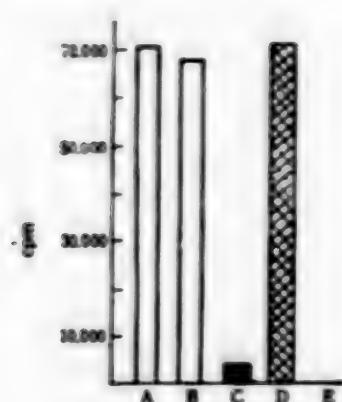


图1 蛋白质的同位素分析

Figure 1. Chromosome Isotope Analysis

Key:

(A)  $[^3\text{H}]$  lipochromosomes have not been cleansed.  
(B)  $[^3\text{H}]$  lipochromosomes have been cleansed three times.  
(C) Liposomes and  $[^3\text{H}]$  chromosomes have been mixed together and cleansed three times.  
(D)  $[^3\text{H}]$  chromosomes.  
(E) Liposomes.

assay of the marked genes re-recorded product (mRNA) of the transfectant. The second is an assay of the ultimate product (the protein or enzyme) expressed by the marked genes of the transfectant.

Mukherjee[1] selected for use as a receptor a mouse cell (A9) that lacked a gene for converting hypoxanthine guanine to phosphoric ribonucleic acid (HGPRT). Next he selected an A9/HRBC2 to serve as a donor cell. This cell was a hybrid cell from the crossing of A9 and a human fibroblast cell. It retained a human X chromosome and its HGPRT gene, a glucose-6-phosphate dehydrogenase (G6PD) gene, and a phosphate glycerine kinase (PGK) gene. Metaphase chromosomes were separated from the A9/HRBC2, and they were encapsulated in liposomes to form lipochromosomes. These lipochromosomes were incubated together with A9 cells. The lipochromosomes fused with the A9 cells, and the metaphase chromosomes and their genes were transferred to the A9 cells to form transfectants. From the transfectant were

obtained HGPRT genes, G6PD genes and PGK genes, and the available gene transfer expressed in terms of corresponding enzymes was assayed.

Willian et al [12] selected minichromosomes for encapsulation in liposomes (lipid minichromosomes) after which they were incubated with kidney cells from a monkey. The lipid minichromosomes fused with the kidney cells from the monkey to form a blank spot, thereby demonstrating that the SV40 DNA had transferred to the monkey kidney cells.

#### b. Gene Transfer and Its Expressed Activity

1) Enzyme Electrophoresis Analysis. Culture donor cells, receptor cells and transfectants into a single cell lamella under certain conditions; then homogenate the cells separately; do a gel electrophoresis of the cell homogenate, and do an activity analysis of the market enzyme. Figure 2 [not reproduced] shows the starch-gel electrophoresis enzyme spectrum for A9, A9/HRBC2, and transfectants (A9/GT3, and A9/GT4) done by Mukherjee in 1978.

Figure 2 A is the electrophoresis enzyme spectrum for G6PD. The G6PD (channel 2) of receptor cell A9 has moved to the positive pole faster than the normal human (KD), the two of them forming a band. The G6PD in the A9/HRBC2 donor cell shows three bands, while the transfectants (A9/GT4, and A9/GT3) as well as the A9/HRBC2 likewise show three bands. The rate of movement of a band is the same as that for the human parent forms. The band in between is an isomer (because G6PD is a dimer).

In Figure 2(B), the electrophoresis enzyme spectrum for PGK, the human (KD) PGK has moved to the positive pole more slowly than the mouse PGK. Since PGK is a monomer that cannot become a dimer, there are only two bands between the transfectants, i.e., the PGK of the two parent forms of the mouse and the human are retained.

Figure 2(C) shows the HGPRT electrophoresis enzyme spectrum with A9 lacking HGPRT activity, while the transfectants (A9/GT4 and A9/GT3) as well as A9/HRBC2 likewise show HGPRT activity. This demonstrates that the human HGPRT gene has been transferred to A9 by the lipochromosomes for which reason the transfectant possesses HGPRT activity.

Figures 2(A), (B), and (C) show the three locations (G6PD gene, the PGK gene and the HGPRT gene) on the X chromosome have shifted as a result of the action of the lipochromosomes. As results of the foregoing electrophoresis suggest, a considerable number of segments of the X chromosome have shifted.

2) Chromosome Band Display analysis. Lipochromosome gene transfer may also be demonstrated through chromosome band displays. Mukherjee used chromosome band display techniques to analyze chromosomes in transfer systems, discovering the form of transfectant genomes to be virtually identical with A9. Analysis of the C and Q bands revealed no additional visible segments of human X chromosomes that were not complete X chromosomes or that had not combined with A9 genomes, thus demonstrating that the transfectant had produced the transfer of some X chromosomes. At least three X-chain genes had been transferred by the lipochromosomes from one eukaryocyte to another eukaryocyte.

3) Use of a special culturing medium to select the transfectant. The transfectant is removed from a HAT culturing medium and the minimum necessary amount of culturing medium is used for culturing, with a return to the HAT culturing medium following reproduction. After repeated culturing in selective and non-selective culturing media, the activity of the transfectant in the HAT culturing medium will be very good, thus showing that the transfectant retains HGPRT genes, and that the transfectant is stable.

#### 4. The Huge Potential of Lipochromosomes for Transferring Eukaryocytes

In recent years, outstanding success has been achieved in research abroad on the use of lipochromosomes as carriers of eukaryotic genes, fully demonstrating the huge potential of lipochromosomes in the transfer of eukaryotic genes.

a. Large Yields of Lipochromosomes Readily Obtainable. Since lipochromosome preparation techniques are not very difficult, and since chromosomes may be readily encapsulated in liposomes, simultaneous with the preparation of lipochromosomes, chromosomes may be easily encapsulated in liposomes.

b. Increasing Chromosome Stability. Experiments have demonstrated that once chromosomes have been encapsulated in liposomes they are protected from damage by enzymes. Table 4 shows clearly that free minichromosomes lose vitality following processing DNase. When incubated together with monkey kidney cells, virtually no blank spots are formed; however, after minilipochromosomes are processed in DNase, they maintain fairly high biological activity, and are very able to form blank spots. Not only are lipochromosomes resistant to DNase, as compared with free chromosomes, they are able to survive for a fairly long time at low temperatures without losing vitality. For example, they may be kept for 2 weeks at 4 degrees Centigrade in nitrogen. This high stability of lipochromosomes and receptor cell membranes (the effects of ingestion, fusion, and carrying an electrical charge) help the transfer of chromosomes or chromosome fragments to the cytoplasm of receptor

cells, and then from the cytoplasm through the karyoteka into the nucleus. Consequently, they are able to greatly increase the efficiency of gene transfer (See Table 3 and Table 4).

Table 3. (Metaphase) Lipochromosome\* Gene Transfer Efficiency

Processing	Transfer Efficiency Jiluo [sic]/ $5 \times 10^6$ cells
Metaphase Chromosomes	3.9 (4.5,2)*
Metaphase Chromosomes + Liposomes	1.3 (3.0,1)
(Metaphase) Lipochromosomes	51 (55,48,52)
(Metaphase) Lipochromosomes + PEG	51 (58,42,55)

\*(Metaphase lipochromosomes) are the lipochromosomes formed after liposomes encapsulates metaphase chromosomes.

\*\*The numbers outside the parentheses are average figures for three experiments; the figures inside parentheses, are for each experiment.

Table 4. (Mini) Lipochromosome\* Gene Transfer Efficiency

Processing	PFU/Mu g DNA/ $\times 10^4$
Free minichromosomes	0.6
Free minichromosomes + DNase	
Minilipochromosomes + DNase	12
Liposome encapsulated SV40 DNA	10

\*(Mini) lipochromosomes are the lipochromosomes formed when liposomes encapsulate minichromosomes.

Table 3 shows the efficiency of gene transfer by (metaphase) lipochromosomes greatly exceeds that of metaphase chromosomes alone, the former being approximately 13 times again as high as the former, and that the efficiency of metaphase chromosomes plus liposome processing is also very low.

Table 4 shows the strength of the minilipochromosomes to be 20 times again as high as for free minute chromosomes.

d. Regulation of Genome Immunocompetence. A change (improvement) occurs in the immunocompetence of chromosomes after encapsulation in liposomes. The main reason for the improvement is that the phospholipids in the lipochromosomes are able to regulate genome immunocompetence. Both Wickner et al [1,6] and Novello [17] et al have reported that when used with externally formed DNA, phospholipids can increase the immunocompetence of DNA polymerase I and DNA polymerase III. Even though the DNA replication mechanism in mammal cells is extremely complicated, experiments [18] with externally formed DNA show that phospholipids are likewise able to increase the immunocompetence of DNA polymerase a, thereby hastening DNA formation. In addition, once phospholipids interact with DNA, the DNA's template vitality can change. The interaction between phospholipids and DNA using heat change and electron microscope techniques has

already been described (Manzoli, F.a., et al. 1972, 1974, 1976, and 1987). In the process of interaction between DNA and phospholipids, some of the polarity in the phospholipid molecules may combine directly with the phosphoric acid radicals in the DNA molecules, and this combination can help the unwinding of the DNA and promote the replication of the DNA.

There is also the possibility that as a result of the interplay between the phospholipid and the histone, the histone's inhibition of the genes was eliminated, thereby allowing an increase in the activity of the DNA template. In fact, quite a bit of research testifies to this. For example, when phospholipids carrying different electrical charges were used to prepare liposome encapsulation of virus DNA, its virility was markedly poor (Willian et al. 1983)[12]. When certain proportions of PC and Cho were used to prepare unilamellar vesicle encapsulation of minichromosome infected monkey kidney cells, virtually no blank spots results. When PS was substituted for the PC, infectiousness increased greatly (approximately twentyfold) suggesting that the negative electric charge carried by the liposomes used in the preparation helped effect a combination with the positively charged histones, thereby eliminating histone inhibition of the genes and permitting replication of the DNA. The foregoing facts show that phospholipids can increase genome vitality in two ways, either by increasing DNA polymerase or by increasing DNA template activity. Some research also indicates [18] that the phospholipid content of the chromatin in mammalian cells is not constant, but changes in a pattern at different times in the cell's cycle. The phospholipid content will be higher when the chromatin is in an active state than when it is in an inhibited state. This fact likewise demonstrates that phospholipids play a regulatory role in gene activity. As to whether one phospholipid or another can increase genome activity to the optimum is a question the elucidation of which will be of extremely great value. This is because the use of this or that phospholipid of large unilamellar vesicles to encapsulate genetic material, and particularly eukaryon genetic material, so that they interact with eukaryotes would both increase the effectiveness of carrier genes and would make genes active.

To summarize the foregoing, lipochromosome carrier gene transfer techniques hold unique advantages over other carrier gene techniques. Nevertheless, this technique has not been long established; methods require further improvement; and the mechanism awaits more thoroughgoing exploration.

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### Planning For Environmental Protection in Seventh Five-Year-Plan

40081001 Beijing ZHONGGUO HUANJING KEXUE [CHINA ENVIRONMENTAL SCIENCE] in Chinese Vol 7 No 3 Jun 87 pp 59-63

Article by Zang Yuxiang [5258 3768 4382], Science and Technology Department, State Environmental Protection Bureau, Beijing: "Cursory Comments About Planning of Environmental Protection in the Seventh 5-Year Plan Period"]

[Text] Abstract: This article capsulizes scientific and technical research plans for national environmental protection during the Seventh 5-Year Plan, as well as the principles to be used in defining tasks, the kinds of research to be conducted, and the basic research goals to be achieved.

The Seventh 5-Year Plan Period is a key period for carrying out complete reform of the economic system and for realizing a quadrupling of gross industrial and agricultural output by the year 2000. It is also an important period for all-around strengthening of environmental control and building the environment, for making scientific and technological preparations, and for setting the stage to bring about a fundamental change for the better in the state of the country's environment by the end of the present century. Therefore, conscientious performance of scientific and technical work in environmental protection during the Seventh 5-Year Plan holds important significance for the realization of the country's strategic goals for environmental protection and for promoting the building of socialist modernization.

The main requirement for rendering a good performance in scientific and technical work for environmental protection during the Seventh 5-Year Plan is good scientific and technical planning. As long ago as 1983, the State Planning Commission, the State Economic Commission, and the State Science and Technology Commission took the initiative in organizing environmental protection specialists to plan scientific and technical work for environmental protection during the Seventh 5-Year Plan Period. As a result, plans were formulated for study of techniques for the prevention and control of pollution from the burning of coal; for urban treatment systems for polluted water and soil, and for turning polluted water into a useful resource. Study of environmental capacity and environmental background values for some places in the country has become a major scientific and technical problem to be tackled during the Seventh 5-Year Plan period. Since 1985, the State Environmental Protection Bureau has also used the scientific and technical problems to be tackled in the country's environmental protection during the Seventh 5-Year Plan as a basis for further increasing the number of environmental specialists and for improving their quality. This has been discussed and approved by the scientific and technical

work conference of the national environmental protection system, and a scientific and technical plan has been formulated for national environmental protection during the Seventh 5-Year Plan.

The scientific and technical plan for environmental protection during the Seventh 5-Year Plan proceeds from the country's realities. Analysis of the state of the country's environment and its economy has suggested some urgently needed research for the country's environmental protection work. Study and solution of these problems is bound to play a tremendous role in giving impetus to the country's environmental protection work.

#### 1. Intensified Research on Environmental Control, Efforts Being Made to Provide Data To Make Environmental Control More Scientific

Environmental control in China is fairly weak at the present time. Statistics show between 30 and 50 percent, and in some places between 70 and 80 percent, of industrial pollution in China as resulting from poor control. For this reason, one important task in environmental protection in the country at present is the strengthening of environmental control. Vice-Premier Li Peng said explicitly at the Sixth Session of the State Council Environmental Protection Commission: "On what do we depend for the prevention and control of pollution? On policies, on controls, and on technology." This fully shows that the strengthening of environmental control is not just a current need in environmental protection work, but is also an important indicator that a Chinese road is being taken in environmental protection. Strengthening of environmental control entails not just continued intensification of the building of environmental protection organizations and improvement in the quality of environmental protection personnel; another important task is to make environmental controls scientific. Analysis of the present state of the country's environmental controls was done in the preparation of scientific and technical plans for environmental protection during the Seventh 5-Year Plan, and environmental control systems, plans, laws, standards and topics for study that included some environmental protection policies were proposed.

##### (1) Study of the Environmental Control System

The scientific and technical plan for environmental protection during the Seventh 5-Year Plan sets forth topics for study pertaining to the environmental control system. Unless our environmental control system is healthy and strong, it will be very difficult to carry out a series of plans, policies, rules and regulations and standards for environmental protection.

Environmental work has a bearing on all sectors, all areas, and all industries; it applies very much to society as a whole and cuts across all walks of life. Without a powerful coordinating and supervisory organization at a high level, and without a scientific division of labor and

cooperation in all control organizations, a good job of environmental control is impossible. There is a general lack of coherence at all levels among environmental control organizations in the country today, and the division of labor among organizations has not been well defined. This is bad for environmental control. The environmental control system should be in tune with the country's economic system. During the Seventh 5-Year Plan, studies of the environmental control system will serve the purpose of providing scientific data for the building of an environmental control system that is in keeping with the country's present economic system.

#### (2) Study of Environmental Planning

Definition of pollution control objectives and objectives for controlling damage to the ecology, and then exercising controls in accordance with these objectives has been the road taken by all the countries of the world in environmental control, and it is also an important control technique that is being applied in China today. However, inasmuch as the country's environmental protection work has not really been made a part of state economic plans for the past 10-odd years, the proportion of funds to be spent on environmental protection has not been defined in state economic plans. Of the several channels for environmental protection funds that have been defined, the percentage under control of environmental protection agencies is very limited. Therefore, even though management by objective has been instituted, in reality, the set objectives frequently have not been attainable. Furthermore, study of environmental protection goals has long been insufficient; frequently goals have been set too high, and difficulties in realizing objectives have not been adequately assessed.

The scientific and technical plan for environmental protection during the Seventh Five Year Plan uses Sixth 5-Year Plan period environmental forecasts in order to meet needs for environmental control, and emphasizes China's development over the intermediate and long term, i.e., in 2000, 2020, and 2050 in formulating environmental protection plan objectives. It also included study of the corresponding percentages of environmental protection funds needed in state economic development plans for the achievement of these goals. In studying environmental plans, representative areas of the country were also selected where studies could be made of regional environmental planning methods and steps to be taken for the purpose of providing needed methods and techniques for the country's future implementation of environmental plans, and to provide data for the formulation of environmental plan norms.

(3) Study of Environmental Laws. Legal control is the most compelling kind of control. During the past 10 years and more, China has devoted extremely serious attention to legal control of environmental pollution. The country's constitution explicitly provides for "national environmental protection and improvement of the living environment and the ecological environment, and

the prevention and control of pollution and the social effects of pollution." In addition, "The Environmental Protection Law of the People's Republic of China" has also been promulgated together with a series of separate laws pertaining to protection of the environment, and environmental laws for some areas. These laws have played an important role in improving the ecological environment, in preventing and controlling pollution, and in heightening people's consciousness.

China's environmental laws are still not on a completely sound footing today; sometimes legal responsibility is not explicitly assigned; and there are no specific policies pertaining to awards and preferential treatment. In particular, the scientific nature and feasibility of current environmental standards that serve as a basis for law enforcement are poor. Consequently, the power of environmental laws cannot be brought to bear.

The scientific and technical plan for environmental protection during the Seventh 5-Year Plan makes use of the country's environmental legal system for steady improvement and strengthening of the country's environmental laws, and to provide scientific data for the phased building of an environmental control system guaranteed by law. Study of environmental laws requires not only study of environmental legislation, but also penetrating study of the country's administration of justice in environmental cases.

The scientific and technical plan for environmental protection during the Seventh 5-Year Plan includes study of the country's environmental standards by way of achieving strict enforcement of environmental protection laws. As a result of this study, pollutant emission standards based on regulation of total volume are to be phased in to replace the present system of pollutant emission standards based on density. Institution of a system of standards based on control of total volume will not only better insure improvement of environmental quality, but should also promote a rational pattern of distribution of industry, spur steady progress in production technology, and make this system of standards more advanced and more rational. In studying this system of standards, not only is it necessary to take into consideration the special environmental characteristics and functional requirements of regions, but also to do a good job of analyzing the economics of technology, the better to formulate pollutant discharge standards that are more in keeping with the country's circumstances. The scientific and technical plan for environmental protection during the Seventh 5-Year Plan emphasizes study of local discharge standards. Zoning of functional areas, the setting of standards for environmental quality, calculation of the environment's capacity for pollutants, and determination of the total amount of pollutants discharged are used in conjunction with an analysis of the region's economics of technology to set apportionment rates for all sources of pollution.

The scientific and technical plan for environmental protection during the Seventh 5-Year Plan not only calls for a system of standards for the water environment and the atmospheric environment, but also calls for the study of quality standards for the soil environment, standards for the discharge of solid wastes, and standards for offensive odors, thereby enriching and perfecting the country's existing environmental standards.

#### (4) Study of Environmental Policies

Environmental policies serve to guide the exercise of environmental controls, and play a decisive role in coordinating the building of the economy and in building the environment. Therefore, intensified study of certain environmental policies, analysis of results obtained from the implementation of these environmental policies, and heightened consciousness about implementation of these policies are extremely important in further strengthening environmental control.

During the past 10-odd years, China has formulated a series of environmental protection plans and policies such as the "Three In Steps," the "Three Benefits," and the "Complete Control Through Precautions First, Linked to Prevention and Control." All of these policies have been rooted in China's national circumstances and have been distilled from practice. However, today there is a certain shortfall in the implementation of these policies. Take the policy of "Complete Control Through Precautions First, Linked to Prevention and Control," for example. Despite our formulation of a series of concrete actions to be taken for the implementation of this policy, such as preparation of environmental impact assessments and taking three simultaneous actions at the outset of new projects; despite the technical transformation of old enterprises as well as their closing, suspension, merger or relocation; despite fining enterprises that discharge excessive amounts of pollutants, etc., the focus of these measures has been primarily on individual sources of pollution rather than on a wider area. Specific technical policy actions are missing. Consequently environmental results have not been notable. For this reason, in the study of environmental protection policies, the scientific and technical plan for environmental protection during the Seventh 5-Year Plan emphasizes comprehensive prevention and control policies for area-wide environmental pollution, using the study of techniques for comprehensive prevention and control of area-wide environmental pollution during the Sixth 5-Year Plan period as a basis for highlighting the study of policies. This should give powerful impetus to comprehensive prevention and control of area-wide pollution in China.

#### 2. Study of Techniques For Strengthening Environmental Pollution Control, and Efforts to Provide a Store of Technical Data For Environmental Control During the 1990's

Though reliance on environmental control to solve environmental problems is an effective measure of strategic significance in today's environmental protection endeavors, there is a limit to the environmental problems that environmental controls can solve, and ultimately reliance must be placed on engineering projects to improve the quality of the environment.

The scientific and technical plan for environmental protection during the Seventh 5-Year Plan focuses on the current state of China's environmental pollution, and takes firm grip on the problem of harnessing pollutants that cover large areas, such as the problem of harnessing the dust and sulfur dioxide that creates atmospheric pollution; the problem of controlling organic compounds in urban sewage that pollute bodies of water, the processing and disposal of toxic and harmful industrial effluent in solid wastes, etc. It calls for widespread study of practical techniques that cost little money and produce quick results.

#### (1) Study of Techniques For Handling Water Pollution

Pollution of the water environment is a conspicuous problem in China's environmental pollution. Results of an early 1980's survey of 878 rivers shows that 5,322 km of a total of 92,806 km of waterways contain foul smelling water in which fish and crustaceans have become extinct. Seventeen of the country's major rivers have been polluted. In particular, sections of rivers that flow through cities are universally polluted.

Pollution of the country's water environment has resulted primarily from the year by year increase in urban pollution, and the discharge of pollutants at will in the absence of effective control measures. Today, China's cities produce 18 billion tons of sewage annually (according to statistics from 75 cities), only between 2 and 3 percent of which is treated. In light of the country's economic circumstances at the present time, the investment of large sums in two stage sewage treatment plants is impossible in the near term. Therefore following an analysis of the state of the country's water environment and of the state of the economy, and on the basis of a study of the environment's capacity during the Sixth 5-Year Plan period, the scientific and technical plan for environmental protection during the Seventh Five Year Plan calls for the study of a combination of artificial treatment and natural purification for the treatment of urban sewage in multiple ways, principally through natural purification. Bearing in mind the country's natural conditions, the scientific and technical plan for environmental protection during the Seventh 5-Year Plan calls for study of a system that emphasizes development in arid areas of north China of the processing of urban sewage for use on the land, thereby organically linking the processing of urban sewage and the turning of sewage into a resource. In south China areas that are near large bodies of water, and in cities along the seacoast, it calls for study of techniques for the discharge into rivers and into the sea of urban sewage after one stage processing.

making full use of the self-purification capabilities of large bodies of water. Where conditions permit in medium and small urban areas, techniques for using oxygenation ponds to process urban sewage should continue to be studied, every effort being made to combine processing with use, rather than just processing, so as to derive greater economic benefits and environmental benefits. In cities where environmental quality requirements are high, further study should be given new technology for two stage, high efficiency processing of sewage using low consumption of energy. These ideas fit in fairly well with China's national circumstances. Many cities in north China are located in water short areas, while quite a few cities are close to large rivers and the open sea with a substantial water environment capacity. If these techniques prove successful, they will give extremely great impetus to urban sewage control in China and will yield marked environmental and economic benefits.

The study of a system for processing urban sewage for use on the land, and of techniques for discharging urban sewage into rivers and the sea following simple processing that are called for in the scientific and technical plan for environmental protection during the Seventh 5-Year Plan, differ from traditional land irrigation and the discharge of sewage into rivers and the sea of the past both conceptually and in terms of technical requirements. In traditional irrigation, no consideration was given to the processing of urban sewage, but rather urban sewage was used primarily for its value as a liquid fertilizer. Past discharge of urban sewage into rivers and the ocean simply used rivers and the ocean as cesspools, no consideration being given to issues such as the protection of bodies of water or the ability of bodies of water to purify urban sewage. Therefore, study of a system for processing sewage for use on the land not only provides an economically beneficial technique for handling urban sewage, but also offers a solution to the problem of polluting the land and bodies of water that is created by lack of scientific management of irrigation and the senseless release of sewage into the rivers and the ocean.

In the implementation of measures such as the system for treating sewage for use on the land, the discharge of sewage into rivers or the sea following simple processing, or the processing of sewage in oxygenation ponds that are called for in the study of techniques for processing urban sewage, rigorous control must be exercised over industrial wastes containing heavy metals, and not readily biodegradable toxic and harmful organic substances.

For sources of pollution for which no fairly good processing techniques have been found, such as the effluent from paper manufacture, waste water from printing and dyeing plants, and waste water containing heavy metals from the electroplating industry, scientific and technical planning for environmental protection during the Seventh 5-Year Plan also emphasizes further study.

#### (2) Study of Techniques For Controlling Atmospheric Pollution

Atmospheric pollution is fairly serious in China. In some cities particulate matter suspended in the atmosphere reaches nearly 100  $\mu\text{g}$  per cubic meter, several times again as high as the amount in the city reported by the World Health Organization as having the most serious atmospheric pollution, Calcutta. The sulfur dioxide content of the atmosphere in some of China's cities is also seriously in excess of standards, with some cities suffering damage from acid rain. The main reasons for the fairly serious atmospheric pollution of China's cities is the burning of coal as a primary source of energy. For this reason, the scientific and technical plan for environmental protection during the Seventh 5-Year Plan focuses particular attention on the country's atmospheric pollution and emphasizes the study of techniques for harnessing pollution from the burning of coal, including study of the development of types of coal for use in industry and in daily life, high efficiency dust elimination techniques, techniques that use new type boiling furnaces to fix the sulfur in coal, and techniques for the elimination of smoke and the removal of sulfur by thermal power plants, thereby providing a series of important practical techniques for solving pollution resulting from the country's burning of coal, for effective improvement of the environmental quality of the country's atmosphere. In addition, plans have been laid to study the factors that contribute to acid rain in the country, its spread, and the damage it causes.

In recent years, a dramatic increase has taken place in the number of motor vehicles in some of the country's cities. This has caused motor vehicle exhaust gas pollution. Consequently, study of techniques for controlling motor vehicle exhaust gas pollution has also been made a part of the scientific and technical plan for environmental protection during the Seventh 5-Year Plan.

#### (3) Study of Solid Waste Processing Techniques

Pollution caused by solid waste has not previously been sufficiently understood nor has sufficiently serious attention been given to it. Several incidents involving pollution have demonstrated that without proper control and processing of solid wastes (particularly harmful and toxic wastes), they will seriously pollute the environment, and some of the pollution of the soil and bodies of water, in particular, will be irreversible. Therefore, the scientific and technical plan for environmental protection during the Seventh 5-Year Plan stresses study of methods for the processing and disposal of harmful and toxic industrial waste in order to provide data for the building in China of centralized processing facilities for toxic and harmful wastes.

#### (4) Study of Noise Control Techniques

The scientific and technical plan for environmental protection during the Seventh 5-Year Plan lists noise pollution as an important issue in the urban environment. During the Seventh 5-Year Plan period, stress is to be given the study of urban traffic noise control.

#### (5) Study of How to Prevent and Control Pollution From Township and Town Enterprises

The scientific and technical plan for environmental protection during the Seventh 5-Year Plan emphasizes study of not only techniques for controlling water pollution, atmospheric pollution, the processing and disposal of solid wastes, and noise control, but also lists topics for study relating to the increasing problem of environmental pollution caused by township and town enterprises. Available statistics show 12 million township and town enterprises in the country with a gross output value that surpasses the output value of agricultural production, and that is increasing at an annual 14.5 percent annually. Development of town and township enterprises plays a very important role in invigorating the rural economy, but the environmental pollution that it causes is also rather serious. Generally speaking, town and township enterprises are widely scattered, have antiquated technology, use resources inefficiently, consume large amounts of energy, and cause great pollution. They also lack the funds to control pollution, and quite a few enterprises onesidedly pursue economic results, no thought whatsoever being given to environmental results. Therefore, unless the problem of pollution by town and township enterprises is solved, environmental pollution will be shifted from the cities to the rural villages, its sources spreading from points to wide areas resulting in even greater damage to the country's environmental ecology. For this reason, the scientific and technical plan for environmental protection during the Seventh 5-Year Plan will study environmental pollution by town and township enterprises from the standpoint of policies, planning, and control techniques.

#### 3. Increased Study of the Effects on Human Health of Natural Protection and Environmental Pollution in an Active Effort To Provide Data for Policies

Ours is a vast land with a large population, the amount of resources per capita not being plentiful by any means. The amount of biological resources per capita, in particular, is very small, resulting in great pressure on the environment. How to maintain a fundamental balance in the ecological environment is an issue that merits study. In this regard, the scientific and technical plan for environmental protection during the Seventh 5-Year Plan calls mostly for study of effective protection and equitable development of resources for use in already established natural protection areas, study of protection policies and laws to protect endangered plant species, as well as study of a benign cycle in the country's agroecology. Study of a benign cycle in the agroecology has begun only during the past several years. During the Seventh 5-

Year Plan, existing ecological pilot projects will be used as a basis for development in the direction of better norms and greater quantification, study thereby becoming more thoroughgoing.

One of the fundamental objectives in protecting the environment is the protection of human health. Heretofore, there has been insufficient study of the effects on human health of environmental pollution. Therefore, the scientific and technical plan for environmental protection during the Seventh 5-Year Plan emphasizes study of the effects on human health of heavy metals pollution, environmental pollution caused by the burning of coal, and motor vehicle exhaust gas pollution for the purpose of providing data for policies.

#### 4. Serious Attention to Turnovers of Scientific and Technical Achievements in Environmental Protection in an Effort to Increase Economic and Environmental Benefits From Scientific Research

Formerly scientific and technical planning for environmental protection devoted attention only to research projects handed down from above, caring little about whether scientific and technical achievements could be translated into productivity. This resulted from long-standing shortcomings in the scientific and technical system itself, which divorced scientific research from production. The scientific and technical plan for environmental protection during the Seventh 5-Year Plan calls for the study of turnovers of scientific and technical achievements in environmental protection in order to translate these achievements into productivity as soon as possible. The scientific and technical plan for environmental protection examines production practices to identify scientific research achievements that may feasibly be collected, collated, evaluated and given further promotion, the better to serve production and control. At the same time, other scientific research achievements are also to be categorized, collated, evaluated, and compiled in a planned way to produce coherent data. The collection and spread of these scientific research achievements not only makes them accessible for production and control, but also points the direction for deeper research. It also helps overcome the widespread low level duplication of research that now occurs because information is not disseminated.

The problems and goals that the scientific and technical plan for environmental protection during the Seventh 5-Year Plan focuses on are major environmental problems that are currently in urgent need of solution in China. Since these problems touch on many different academic fields, some will require multi-discipline cross-fertilization and joint efforts by different sectors, which means a certain amount of complexity. Consequently, fulfillment of the scientific and technical plan for environmental protection during the Seventh 5-Year Plan is a rather daunting task. We must strive to do a good job of reforming the scientific and technical system, of

strengthening scientific and technical control of environmental protection, and of concentrating forces to insure complete fulfillment of the scientific and technical plan for environmental protection during the Seventh 5-Year Plan. 9432

### Evaluation Index System For Importing Foreign Technology Proposed

Tianjin KEXUEXUE YU KEXUE JISHU GUANLI [SCIENCE OF SCIENCE AND MANAGEMENT OF S&T] in Chinese No 8, Aug 87, pp 9-10

[Article by Chen Guixuan [7115 6311 6693], Jinzhou Municipal Foreign Economic Trade Office: "On an Evaluation Index System for Importing Technology"]

#### [Text] The Significance of Establishing an Evaluation Index System For Importing Technology

Since opening up to the outside, China has imported a great deal of advanced technology which has greatly promoted China's technological renewal and at the same time has also accelerated enterprise technological transformation. However, importing technology should still be analyzed and evaluated using a scientific indexing system from the angle of quantity and an evaluation index system for imported technology should be gradually established.

From the angle of the macroview, establishing an evaluation index system for importing technology will be beneficial in examining the necessity and possibilities of importing technology within a broader area; readjusting technology importing tactics correspondingly and studying the strategy of China's technological development. The most fundamental cause of such problems as duplicate imports, reckless imports, and improper digestion of imports which have appeared in the last few years is the lack of a scientific and accurate evaluation index system. An evaluation index system serves as an indicator system for a policy-making control system for importing technology and provides information feedback, provides data for objective change and regulatory variables and thus introduces into policy making factors whose influence is or is not decisive on technological importing and grasps the regularity and process of this system's dynamic change. At the same time, by using an evaluation index system for importing technology to assess the macroeconomic results, the advantages and disadvantages, success and failure of importing technology and studying the dynamics, levels, and development trends of technology importing nationally or regionally we can regulate or control the scope, rate and direction of importing technology at any time and make relevant plans and policy decisions.

From the angle of the microview, if we have an evaluation theory and method for importing technology, then regions and enterprises will be able to make policy decisions on the basis of macroeconomic needs and local

and enterprise possibilities by means of the evaluation index. At the same time, the level of technology, degree of adaptation, and degree of exploitation can also be specifically evaluated so that an enterprise can assess the economic benefits after importing the technology which will facilitate the further study of absorbing the technology and the possibility of expanding innovation. The economic results of enterprise importing, not importing, and post-importing in similar industries can be analyzed and compared and evaluate the degree to which importing technology influences an enterprise's technological progress.

From the point of view of theoretical research, at present China has done many studies on the principles, policies, and management methods of importing technology, but very little analysis, research or summary on the results produced after execution. In particular, a quantified evaluation measure which has a scientific basis has not yet been proposed. Thus, establishing an evaluation index system for importing technology is most urgent and necessary.

#### Basic Principles of Establishing Evaluation Index System

##### 1. Scientific nature

Importing technology is an important part of China's technological development strategy. Therefore, an evaluation index should be established on the foundation of survey research and scientific analysis and summary of the existing special nature and laws of importing technology so that there will be a quantitative scientific analytical evaluation standard for importing technology.

##### 2. Objectivity

The selection, determination, connotation, and extension of the index on a scientific basis should proceed from the actual situation of the object of the evaluation, and be proposed with reference to international and national environments, conditions, and evaluation methods and it should be objective.

##### 3. Interrelatedness

There are relationships of dependence, interpenetration, and constraint at different levels in technological factors, technological mix and between structures. Thus the evaluation index system should be able to reflect this and through unifying the discussion of the qualitative and the quantitative (time, probability) between indices be able to form a linkable, comparable, and organically combined entity.

##### 4. Systematicness

Importing technology is a very complex system, assuming many states due to the influence of time and space, as well as exhibiting many factors due to restrictions of

foreign and domestic economies and natural and geographical environments. It involves the complex relationships of man and man, man and nature, and man and society. At the same time, each specific importing technology process also exhibits different characteristics. This complex and comprehensive decision must view the object from the viewpoint of the system as an organic whole, establish an evaluation index system which is interrelated and organically integrated and evaluates at different levels and in different scopes.

### 5. Particularity

Exploring an evaluation index system should be firmly grounded in the principle of "one innovation and two borrowings". In establishing a corresponding evaluation index system and building a basic framework on the basis of the characteristics of importing technology, there are some earlier economic technology evaluation indices which can be revised, shifted, and applied. In this way, contradiction with the domestic evaluation system or duplication and omission can be avoided when applying the importing technology evaluation index.

#### Basic Conception of Establishing an Evaluation Index System

On the basis of scientific research methods and the above principles, an evaluation index system can be established through a quadripartite index: A, technology selection evaluation index; B, technology implementation evaluation index; C, technology mix evaluation index; D, technology benefits evaluation index. Each of the above parts also includes certain central evaluation indices and the evaluation is carried out by certain indices revolving around one concept. According to this structure, we can obtain a complex index system made up of a certain series of indices (see attached table [not reproduced] for detail). It should be noted that the main indices given in the table are not complete: many more indices can be derived and differentiated from the indices in the table. Here will will give a simple demonstration of the basic thinking and principles regarding these four parts and the establishment of the central indices.

#### (1) Setting Up the Technology Selection Evaluation Index

Selection of importing technology is the prerequisite for importing and determines the direction of technological progress. Technology selection can be evaluated through four central indices. (1) Setting Up an Index For Evaluating Objective Policy Decisions. The goal is to consider the actual situation of China's macroview importing technology policy, evaluate the impact of China's technology system and technological equipment, evaluate the quality and success of planning and major policy decisions, etc. (2) Establishing a Technology Environment Evaluation Index. (3) Establishing a Social Environment Evaluation Index. The reason for establishing these two indices is so that technology importing to China will first

of all provide a favorable technological environment and social environment. In terms of theory, we can convert such factors as politics, society and psychology into a series of restrictive conditions and then evaluate in index form. (4) A Feasibility Study Evaluation Index must also be set up.

#### (2) Setting Up a Technology Implementation Evaluation Index

This part is made up of four central indices which reflect investment of funds, time benefits, labor investment and digestion and absorption and is used to reflect the investment and implementation process for importing technology. (1) Through the Funds Investment Index, the funds investment status quo is evaluated to adjust the investment direction, control investment scale and improve investment mix to provide data for formulating investment policy. (2) Setting Up the Index of Labor Investment and Index of Digestion and Absorption. Successful technology importation should consider the matching of materials, the combination of personnel and materials, and the contact between people (such as technological exchange and training). This is because they directly influence our understanding and mastery of technology and are related to choosing and digesting technology. (3) The considerations in setting up an Index Reflecting Time Effect are: First, technological progress is not random: each technology has its life cycle and it must be evaluated using a time concept to avoid a sweeping evaluation of age level. Second, viewed from the perspective of the process of technology transfer, there is bound to be a time delay in the transfer of technology from the country where it was first used to other countries. This time differential reflects the gap in the application direction of a technology of a certain level between countries. Thus it should be noted that a certain technology can only be successful if it is imported at the appropriate time. Third, the time effect of invested funds, i.e., does it achieve the anticipated benefits within the anticipated time.

#### (3) Establishment of a Technology Mix Evaluation Index

The goal of establishing this index is to analyze the mix and rate of digestion in evaluating the factors, mix, and system of importing technology; taking into consideration the relative numbers of the mix and the absolute numbers of types of technology China imports, analyzing the transfer and distribution of the "mix step change" of technological development. But this is also related to the funds invested. Thus, this index also is linked with the indices in part B. (1) The Technology Life Cycle Evaluation Index has an intimate relationship with the time effect index and should be evaluated by world technological life cycle. This is because, from the perspective of the present stage, in the mix of technology importing by China, purchase of equipment and production lines is still primary and thus an Index Reflecting Technology

Level is derived through proposing an index for evaluating the technology life cycle. (2) Concerning establishing a Technology Distribution and Transfer Evaluation Index, first, technology transfer determines the breadth and depth of technological progress. Evaluating the transfer of imported technology to different industries or economic levels (transfer or promotion) is also a question of digestion and absorption in the broad sense. Next, to a certain degree, technology transfer is determined by technology selection (related to the indices in part A). If the technology is adaptable and broad in application, and the direction is on target, then the transfer rate is high and the rate of technological progress may accelerate. Finally, when a certain technology is to be imported for a project, it is bound to prompt another project to import another technology and this situation of importing related technology should be evaluated and mastered comprehensively.

#### (4) Establishing a Technology Benefits Evaluation Index

We summarize technology benefits by the Social Benefits, Technological and Economic Benefits, and Management Benefits introduced by the imported technology and the impact and constraints on the benefits in these three areas. This is also the scope of the index produced and what should be noted is that the benefit of importing technology not only includes the benefits coming in from the equipment and technology, but also the benefits brought in in the software form of knowledge, skill, and management. The degree of savings in such areas as capital, labor, costs, resources, manpower, and talent introduced by application of imported technology in the country, department and industry should also be considered.

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#### Inter-Enterprise Technology Transfer Issue Examined

40080019 Taiyuan JINGJI WENTI in Chinese  
25 Aug 87 pp 21-23

[Article by Liu Zhong [0491 6850]: "An Examination of Inter-Enterprise Technology Transfers in China"]

[Text] In a commodity economy technology is a commodity. This is acknowledged as an objective reality in China now. Expanded commercialization of technology in recent years has led to unprecedentedly flourishing technical trade. Inter-enterprise tech transfers, however, remain a weak link. A question worthy of discussion is how to speed up such transfers. This article therefore, is a preliminary discussion of the conditions and economic benefits of inter-enterprise technology transfers as well as development strategies and measures.

#### I. Analysis of the Preconditions for Inter-Enterprise Technology Transfers

Inter-enterprise tech transfers include advanced production technologies, equipment and manufacturing technologies and management and administration technologies. Examples include production processes, material prescriptions, equipment and product manufacturing blueprints and techniques and other technical data as well as technical consulting and training, technical services and so on. Are the conditions mature now for inter-enterprise tech transfers in China? The answer is yes.

First, the commercialization of technology provides the conditions for inter-enterprise tech transfers in China. From a world perspective, technical trade is relatively developed worldwide. The commodity nature of technology has been understood inadequately in China in the past and we have failed to acknowledge that a socialist economy is a commodity economy. The realm of commodity exchange is narrow and technologies have been excluded from commodities. Technologies have been set aside as samples and displays or they have been used as uncompensated gifts. Technical transfers usually took the form of uncompensated aid, counterpart support and so on. Bilateral commodity exchange relationships between technology buyers and sellers were artificially severed. This made circulation of technology as a commodity impossible. The commodity economy has grown following reforms in economic systems in recent years and people have a new understanding of technical commodities. Technology has entered the realm of circulation and is undergoing compensated exchange among enterprises.

Second, China's economy and technology have developed unevenly. This provides a broad market for inter-enterprise tech transfers. China's large population and vast area have led to regional disparities in economic development conditions. Moreover, improper deployments in forces of production have existed for a long time. This makes technological disparities among enterprises inevitable. Generally speaking, China's coastal regions have more advanced technologies while frontier and interior regions have rather backward technologies.

Technologies are advanced in urban enterprises but relatively backward in township and town enterprises. This deployment of technology assures that some regions and enterprises will have to import technologies while other regions and enterprises will have the capacity to supply technologies. This makes it necessary to reduce technical disparities by correcting irrational deployments of forces of production and imbalances in the distribution of technology. The inevitable result will be technology circulation among enterprises. Technology circulates on a gradient from high to low. It is transferred from coast to interior, from cities to countryside and from advanced to backward enterprises. This is an objective law of S&T transfer. Nevertheless, today's rapidly developing S&T makes it fundamentally impossible as well as unnecessary for any enterprise, any sector or even any country to develop and manufacture all of

the technologies it needs. Instead, it should depend mainly on technology circulation and transfer. Thus, given present conditions, there is a vast market for inter-enterprise tech transfers in China.

## II. The Current Situation, Forms and Characteristics of Inter-Enterprise Technology Transfers in China and an Evaluation of Their Social and Economic Benefits

Technical markets are a new development following reforms in economic systems and growth of the commodity economy. Technical trade has grown vigorously in China in recent years. Technology markets can be found throughout the country and the volume of technical trade grows without letup. Technical trade plays an increasingly important role in accelerating the shift of S&T achievements into production and promoting technical progress through China. However, the recent situation in technical trade has been that tech transfers have focused on institutions of higher education and scientific research units. There also have been some tech transfers to individuals. Insufficient attention, however, has been given to inter-enterprise tech transfers. Thus, ways to develop inter-enterprise tech transfers are now urgent and real questions. Still, such transfers are growing slowly and are somewhat underdeveloped. It should be acknowledged, however, that the impetus from the tide of commercialization of technology has meant gratifying progress in inter-enterprise tech transfers in China. This is especially true of the promotion of horizontal economic and technological integration, which has started to invigorate such transfers. A large number of advanced technologies hidden in enterprises are being developed, enterprises are organizing various forms of tech transfers based on the characteristics of local regions and enterprises, and inter-enterprise tech transfers have begun to enter a new stage. An examination of the current patterns of these transfers in China indicates that they mainly take the following forms:

1. **Technology transfers and integrated production.** This pattern mainly refers to enterprises which transfer their products and manufacturing technologies, complete sets of blueprints, technical documents and so on to the assignee in the form of technology shareholding. Both sides produce jointly, manufacture product nameplates jointly and distribute the profits to either side according to a specific proportion. An example is the gas shielded welder designed by the Tianjin Municipality Welder Plant. This is a highly efficient energy-saving product which the state has attempted to popularize. Because large numbers are needed in northeast China, the plant signed a tech transfer agreement with the Mudanjiang City Electric Welder Plant in 1984. The Tianjin Municipality Welder Plant supplied, for compensation, complete sets of blueprints, technical documents, technical guidance and key components. The Mudanjiang plant supplied the plant building, personnel and equipment. The two plants produced jointly, the product nameplates and labels were jointly manufactured by the two plants and the two sides distributed the profits according to a specific proportion.

2. **Technical transfers and cooperative production.** This pattern mainly refers to an enterprise transferring its products, manufacturing technologies, blueprints, technical documents and other things to a recipient. The recipient organizes production and the transferer assists in technical guidance and in product inspection and acceptance. Trademarks, however, are not transferred. The transferer deducts a tech transfer fee according to a specific proportion. An example is the tech transfer and cooperative production contract signed between the Tianjin Power Generating Equipment Plant and Hunan Province's Cili [County] Hydropower Equipment Plant. The Tianjin Power Generating Equipment Plant provided the Cili plant with complete blueprints for 3,200 kW hydropower generators and the latter organized production. The Tianjin Power Generating Equipment Plant provided technical cooperation in manufacturing the key components of the products and in product assembly, inspection and acceptance. Only the product trademarks were provided by the recipient of the transfer. The Tianjin Power Generating Equipment Plant deducted a tech transfer fee according to a specific proportion.

3. **Product transfers.** This pattern mainly refers to enterprises which transfer their main former products and manufacturing technologies to a recipient to concentrate efforts on developing new products. The recipient of the transfer organizes production and the transferer simply deducts a tech transfer fee according to a specific proportion. An example is the Hunan Machine Tool Plant, which transferred a key product, the G73 piercing saw, to a suburban plant and trained its technical personnel. The plant produced 300 units in 1985 with a value of output of 750,000 yuan. The transfer of the main components for 42 product labels and trademarks by machine building departments in Hunan Province to over 500 township and town enterprises for production in 1985 is another example. The key products dispersed to township and town enterprises in Changsha City alone had a value of output of 106 million yuan and profits and taxes of 28.80 million yuan.

4. **Technical consulting services.** This pattern mainly refers to technical personnel in some key enterprises providing, for compensation, technical consulting services to technically backward medium and small scale enterprises and township and town enterprises. An example is the considerable number of large enterprises under central and provincial jurisdiction in Wuhan City which have rather strong technical competence and rather high management levels. To make full use of their technical and administrative advantages, Wuhan City in the past few years has organized more than 500 engineering and technical personnel, key management cadres and experienced technicians from 41 enterprises under central and provincial jurisdiction to provide compensated consulting services to medium and small enterprises under city jurisdiction. They include the Wuhan Heavy Equipment Plant, the Wuhan Boiler Plant, the Wuhan Shipyard and others. They have provided consulting

services to 37 plants for key products including bicycles, electric fans, washing machines, clothing, baby carriages, radios and others. According to statistics, these enterprises have developed more than ten new products as a result of the consulting services, and they have completed attacks on 184 key technical problems and designed and manufactured 16 production lines. Obvious economic results have been attained. Through technical consulting services, the Wuhan Washing Machine Plant reorganized blueprints and technical documents for equipment and for product inspection and testing. It built a washing machine production line which improved produce quality and increased output. It has been named one of China's best washing machine brands. Inter-enterprise tech transfers have their own special qualities. First, all such transfers involve horizontal economic integration. Some involve tech transfers to organize integrated enterprises or branch plants. The transferers usually are unwilling to give up their rights over more advanced technologies or famous brands in tech transfers. They often adopt a pattern for cooperative production. The usual technologies and products, however, often involve transfers of complete technologies and products without concern for ownership rights. Second, the technologies and products transferred in inter-enterprise tech transfers usually go into production quickly and provide fast results. The economic results are rather good and both sides can obtain reasonable economic benefits.

### III. Strategies and Measures for Accelerating Inter-Enterprise Technology Transfers

Inter-enterprise tech transfers developed rather late in China. They are small in range and scale and have developed slowly. In the long-term, however, inter-enterprise tech transfers will become a development trend in technical trade. The prospects for such transfers are promising and there is enormous potential. For this reason, correct strategic principles for invigorating technical trade and accelerating inter-enterprise tech transfers are needed.

1. Pay a great deal of attention to tech transfers of China's advanced technologies and famous products and adhere to the principle of joint orientation toward China and foreign countries. One current trend in technical trade in China is enthusiasm by some enterprises for importing foreign technologies and neglect of Chinese technologies. Of course, imports of foreign technologies are very important, but the achievement of scientific and technical modernization will be impossible if we neglect development and transfer of Chinese technologies. Thus, technical trade should adopt a principle of combining Chinese and foreign transfers. This means importing advanced foreign technologies and more importantly, no neglect of Chinese technologies. We propose that future tech transfers in China be strengthened and especially that the forces organized to participate in domestic technical trade be reinforced. Besides importing advanced foreign technologies, specialized organs

involved in technical importing also should organize tech transfers within China so that our own advanced technologies and famous products are transferred out while advanced foreign technologies are brought in.

2. Reinforce transfers of imported technologies within China. Imports of foreign technologies have grown continually since China opened its doors to the outside world. An analysis of the import situation in recent years indicates overall success and obvious benefits. Imports have had a positive role in raising technical standards in China. However, mistakes have been made during the importing process and there are several problems. The lack of balance in import items is an example. Redundant importing has occurred at times in some regions and enterprises. The deployment of imported items is such that coastal areas have imported more technologies while frontier and backward regions have imported few or even none. Competition for projects has led to redundant importing in some enterprises, while others have lacked the capacity to digest and absorb after importing. As a result, we feel that there should be compensated transfer within China of advanced technologies imported from foreign countries. This could lead to the transfer of advanced technologies after they have been digested and absorbed from the coast to frontier and backward regions in China. This would enable technologies imported redundantly or incapable of performing reasonably to be transferred to regions where they can be used fully. This also would enable transfer of technologies where there has been no capacity for digestion and absorption after importing to enterprises capable of digesting and absorbing them. These would permit the imported technologies to play their roles fully.

3. Pay attention to tech transfers which integrate scientific research with production. In recent years, many enterprises have taken the initiative in forming integrated scientific research and production bodies in conjunction with institutions of higher education and scientific research units. There are, however, some problems at present. Some, for example, have been concerned only with development of a single product and product development has been incomplete. Some have been concerned only with their own development and lack diffusion capability. As a result, these integrated scientific research and production bodies have not played a significant role in technical trade. We feel that in the future, the role of integrated scientific research and production bodies in inter-enterprise tech transfers should be strengthened.

4. Perfect credit systems and increase investments in science and technology. The short-term benefits of S&T items are not as obvious as those of technical transformation. Investment needs increase gradually and the returns to investments are greatest in later periods. As a result, the principle of "small investments, short turnaround, fast results" for bank loans is not entirely appropriate for S&T items. The state should consider the reasonable needs of S&T development projects when

balancing the scale of investments in fixed assets to encourage S&T development. Banks should increase the categories of S&T loans according to laws of S&T development.

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### High-Tech Achievements of Chinese Academy of Agriculture Listed

40081024a Beijing GUANGMING RIBAO in Chinese  
9 Sep 87 9 Sep 87 p 1

[Article: "The Chinese Academy of Agricultural Sciences Organizes Crack Staffs To Develop High-Tech Research—Important Achievements Have Been Made in Another Culture Breeding, Protoplast Regeneration Stem Formation, Animal and Plant Monoclonal Antibodies, Livestock Embryo Transfer and Dissection, Genetic Engineering and Other Fields"]

[Text] While mobilizing over 70 percent of its S&T personnel to face the main battlefronts of agricultural production and carry out applied and developmental research for urgent production needs, the Chinese Academy of Agricultural Sciences also has organized a crack staff to keep pace with international trends in agricultural development and focused on research on advanced and new technologies. They have made several important achievements in another culture breeding, protoplast regeneration stem formation, animal and plant monoclonal antibodies, livestock embryo transfer and dissection, genetic engineering and other fields. Their practice has proven that adherence to the principle of orienting scientific research toward production does not imply neglect of high-tech developments.

The keys to the academy's ability to make repeated achievements in research on advanced technologies and new technologies were better management of scientific research and the momentum created by organizing relevant forces at the academy and institute levels.

First, they required that research institutes with the proper conditions use a foundation of conventional scientific research and work first in less difficult areas of biotechnology and in areas where their technical capabilities were strongest to facilitate concentration of forces for near-term breakthroughs.

In recent years, 16 of the academy's 39 research institutes (and centers) undertook almost 50 scientific research projects and made important achievements in more than ten of them. The topical group led by Li Meifang [2621 2734 5364], for example, used their experience in conventional cultivation and collected experimental data for successful application of new anther culture breeding technologies to breed hybrid paddy rice varieties and shortened breeding periods by three to four years. They bred three superior quality, high output, highly disease resistant improved paddy rice varieties, Zgonghua No. 8, No. 9 and No. 10, which

have been universally welcomed by rice growers in northern China. These improved paddy rice varieties have been extended over an area of 3 million mu and yields have increased by an average of more than 10 percent. Zhonghua No. 8 has been named as a national superior rice variety.

Second, key professionals were transferred and equipment and capital were concentrated to create an academy-level biotechnology research center to assume responsibility for key advanced technology and new technology projects assigned by the state and to coordinate biotechnology work throughout the academy. Although these forces were small in number, the crack personnel and good facilities (compared with other laboratories) gave them a rather strong ability to "assault fortified positions" [study key topics]. The Molecular Biology Laboratory led by researcher Fan Yunliu [5400 0061 0362], director of the research center, placed two types of antigen gene groups into a colon bacillus and then artificially constructed a dual-valence [7175 0116] antigen genetically engineered bacillus in 1986 and made important progress in research on plant genetic engineering. Now this laboratory has established a complete set of plant genetic engineering conversion systems on the basis of a model plant, tobacco, and has successfully transplanted a kanamycin-resistant gene in an agricultural bacillus plasmid into the cells of the forage grass baimaigen [4101 7796 2704]. The forage grass cells containing the resistant gene have been differentiated into roots and buds in the laboratory and are displaying encouraging prospects. Although the research center was established not long ago, its three laboratories have made definite achievements. They have used their technical strong points and expanded cooperation with other research institutes in the academy, which has effectively contributed to biotechnology work throughout the academy.

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### Storm Surge Monitoring, Forecasting System Built

40081024b Beijing GUANGMING RIBAO in Chinese  
17 Sep 87 p 1

[Article: "China Completes a Storm Surge Monitoring and Forecasting System—Many Successful Predictions Have Effectively Reduced Losses"]

[Text] China's State Oceanography Bureau and UNESCO stated at the first International Storm Surge Discussion Conference held in Beijing on 15 September 1987 that:

Although research on storm surges and forecasting in China began rather late, it has developed quickly. China now has completed its own storm surge monitoring and forecasting system and it has made several successful forecasts which effectively reduced losses caused by

storm surges. The State Oceanographic Forecasting Station's "Storm Surge Forecasting Services and Current Forecasting Technologies" project received a second-place state S&T progress award in 1985. China has made significant achievements in recent years in scientific research on basic theories, numerical simulation and forecasting methods concerning storm surges. This is particularly true of research on various types of numerical models covering all of China's seas. This type of wide-ranging research is seldom seen internationally.

At present, China is reinforcing research, monitoring and forecasting of storm surges. Reduction and prevention of storm surge disasters is becoming an increasingly urgent need for coastal economic development and construction and for protection of the people's lives, property and safety. For this reason, China included research on storm surges among projects for attack on key S&T questions in the Seventh 5-Year Plan. This conference saw a wide-ranging discussion and exchange of issues in the areas of storm surge theory, modeling, estimation of danger rates, forecasting technologies, monitoring and safeguards. It undoubtedly will play a positive role in promoting international exchange and cooperation in storm surge research, and it will strengthen China's storm surge monitoring and forecasting capacities and disaster prevention work.

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#### **Tsunami Alert System Established**

*40081024c Beijing PEOPLE'S DAILY (OVERSEAS EDITION) in Chinese 9 Sep 87 p 4*

[Article: "China Actively Develops Research on Tsunami Defenses, Construction of a Tsunami Alert System Is Being Speeded Up"]

[Text] Deputy Director Yang Wenhe [2799 2429 7729] of the State Oceanography Bureau stated at the International Pacific Ocean Tsunami Alert System Conference

held [in Beijing] on 8 September 1987 that China is speeding up construction of a tsunami alert system and will place it into formal operation within two years.

Tsunamis, storm surges, earthquakes, floods, cyclones and tornadoes are the six greatest natural disasters faced by mankind. A tsunami is an enormous rise and fall in the sea surface caused by sea-bottom earthquakes and volcanoes or by storm surges.

According to the presentations, regional tsunamis in China's seas have occurred along the coast from Laizhou Bay in the Bohai Sea in the north to the South China Sea in the south and have occurred once every 21 years on the average.

China now has established more than 200 tide monitoring stations along its coast which closely monitor changes in ocean waves, hydrology and climate and they have laid an excellent foundation for a tsunami alert system. The State Oceanography Bureau also has studied the formulation of comprehensive plans for a tsunami alert system, updated the needed instruments and equipment and speeded up training of professional personnel.

The 26 representatives and observers from 12 nations who attended the International Pacific Ocean Tsunami Alert System Conference convened by the State Marine Environment Forecasting and Research Center discussed methods for improving tsunami defenses in the Pacific Ocean, updating alert system equipment and other issues to establish a complete Pacific Ocean tsunami alert system.

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